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Against the Grain: Why is Timber Underutilised in the Irish Construction Industry Given Its Environmental Properties?

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**AGAINST THE GRAIN:
WHY IS TIMBER UNDERUTILISED IN THE IRISH
CONSTRUCTION INDUSTRY, GIVEN ITS
ENVIRONMENTAL PROPERTIES?**

A thesis submitted to the Dublin Institute of Technology
in part fulfilment of the requirements for award of Masters of Architecture
(M Arch) in The Dublin School of Architecture

By
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January 2018

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Declaration

I hereby certify that the material which is submitted in this thesis towards award of the Masters (M Arch) in Architecture is entirely my own work and has not been submitted for any academic assessment other than part fulfilment of the award named above.

Signature of candidate: *Francis Noel Duffy*

Date: 05.01.2018

Abstract

This study explores why timber is underutilised in the Irish construction industry, given its environmental properties. Defined literature discourse (framed by two timber exemplar case study buildings and themed into procurement, policy and academic sections) is analysed in pursuit of factors that meet the research question. The literature data collected is used to formulate action-based research in the form of a “Wood First” motion, subsequently passed into policy by South Dublin County Council in July 2017. The literature is also refined into questions for a two-stage, fourth-generation evaluation interview process. This process further examines the discourse of industry experts and stakeholders in the Irish construction industry. The findings reveal a complex matrix of relationships, knowledge/communication vacuums and resistance. However, the matrix also identifies positive outcomes which can assist the development of timber in the Republic of Ireland.

Acknowledgements

I would like to sincerely thank my supervisors, Deborah Brennan and Kevin Donovan, for their generous guidance. I am very grateful to them both for sharing their intellect with me. Words cannot express my gratitude.

I admire and respect the Dublin School of Architecture Masters team for their time and commitment to this programme.

I have been privileged to work alongside my peers, Olivia, Mike and Laura.

I must express gratitude to the experts and stakeholders who imparted their experience to me through the interview process.

Family and friends are the ones who tend to carry one through a process such as this, and I would like to thank them, but especially my wife Catherine.

List of Abbreviations & Acronyms

BBM	Bio-renewable building materials
BER	Building energy rating
C16	European grade of structural timber
CAP	Common agricultural policy
CasWood	Project funded by the Department of Agriculture, Food and the Marine
CEN	European Committee for Standardisation
CLT	Cross-laminated timber
CNC	Computer numerical control – automated milling devices
CO ₂	Carbon dioxide
COFORD	Council for Forest Research and Development
Coillte CGA	Cuideachta Ghníomhaíochta Ainmnithe
CPD	Continuing professional development
CPR	Construction products regulations
DAFM	Department of Agriculture, Food and the Marine
DATI	Department of Agriculture and Technical Instruction
DCU	Dublin City University
DIT	Dublin Institute of Technology
ECI	Environmental cost indicators
EPD	Environmental product declarations
EU	European Union
FAP	EU Forest Action Plan
FAS	Foras Áiseanna Saothair – the former state agency in Ireland responsible for employment assistance
GDP	Gross domestic product
GMIT	Galway Mayo Institute of Technology
GPP	Green procurement policy
ICE	Institute of Civil Engineers
IMF	International Monetary Fund
LCA	Life cycle assessment

NMIT	Nelson Marlborough Institute of Technology
NUIG	National University of Ireland Galway
NZEB	Nearly zero energy building
OPW	Office of Public Works
R&D	Research and Development
REC	Research Ethics Committee
Part B	Second part of the Irish Building Regulations (Fire)
RPG	Regional planning guidelines
SDCC	South Dublin County Council
SEAI	Sustainable Energy Authority of Ireland
TD	Teachta Dála – Member of Dáil Eireann
TGD	Technical guidance document
TRADA	Timber Research and Development Association
UBC	University of British Columbia
UCD	University College, Dublin.
UKGBC	United Kingdom Green Building Council
UCL	University College Limerick
UNFCCC	United Nations Framework Convention on Climate Change
WTI	Wood technology Ireland

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List of Definitions

This research is primarily concerned with environmental sustainability, but the word “sustainability” is also used relative to economic and social outcomes. In public policy, sustainability is used, but sometimes it is difficult to know if the message is about the environment, economy or society.

1. Environmental Sustainability is the ability to maintain rates of renewable resource harvest, pollution creation, and non-renewable resource depletion that can be continued indefinitely (thwink.org).

2. Economic Sustainability is the ability to support a defined level of economic production indefinitely (thwink.org).

3. Social Sustainability is the ability of a social system, such as a country, to function at a defined level of social wellbeing indefinitely (thwink.org). It is important to define timber here and its link to wood and lumber.

4. Timber (noun) is wood prepared for use in building and carpentry: “the exploitation of forests for timber” [as modifier] “a small timber building”. Origin – Old English in the sense “a building”, also “building material”, of Germanic origin; related to German Zimmer room, from an Indo-European root meaning build (*The New Oxford Dictionary*).

5. Wood (noun) is the hard-fibrous material that forms the main substance of the trunk or branches of a tree or shrub, used for fuel or timber: “a block of wood” [countable noun] “best quality woods were used for joinery” (*The New Oxford Dictionary*),

6. Lumber (verb) is North American, usually as noun lumbering [no object]: cut and prepare forest timber for transport and sale: “the traditional resource industries of the nation, chiefly fishing and lumbering” (*The New Oxford Dictionary*).

7. Roundwood is the raw material that our sawmill and panel board customers process into high quality timber and timber products (defined by Coillte).

8. BIOeconomy is a sustainable economic model, one which offers holistic sustainability, where policy not only delivers for the economy, but also covers environmental and social sustainability (defined by COFORD).

CHAPTER 1

Introduction

1.1 Introduction

This research is principally concerned with the role of timber in the Irish construction industry, and understanding why the material is underutilised, considering its environmental properties. My professional background and life's work involve policy-making, architectural education and procurement, with each area having an environmental perspective.

Further to reviewing existing literature in the field, this study incorporates field work in the form of local authority participation, and interviews experts in procurement, academy and policy, as well as stakeholder interviews. The study is framed using two case study timber buildings built 33 years apart: Killykeen timber frame holiday homes, Co. Cavan, constructed in 1984 and a contemporary 2017 cross-laminated timber (CLT) house in Tara, Co. Meath.

An initial aim of the research was to table a “Wood First” motion in South Dublin County Council, seeking a local authority/State response. A further aim was to identify reasons for the perceived restricted advancement of timber in the Irish construction industry, through discourse analysis coupled with fourth-generation interview evaluation.

1.2 Background

This research is inspired by my policy-making mandate to seek environmental construction methodologies. I have a Green Party policy-making mandate, having been elected to South Dublin County Council



Figure 1 Deputy Mayor Speech, South Dublin County Council, 2015. (Source: Photograph by Rob O'Connor)

(SDCC) in 2014. I am also a member of the Eastern, Midlands Regional Assembly. Both levels

of government place me in a position where I can effect change in public policy. This is actioned through local authority policy, development plans, and regional planning guidelines (RPGs).

1.3 Research Question and Objectives

Why is timber underutilised in the Irish construction industry, given its environmental properties?

Research objectives –

1. Identify timber’s sustainable properties through peer-reviewed papers and state agency publications.
2. Investigate why Ireland does not have a timber culture from national historical literature.
3. Use the literature research data to propose a “Wood First” motion for SDCC to seek the State’s official position.
4. Identify existing timber relationships and gaps in procurement, policy and academia practices in the Irish construction industry, by analysing the discourse of industry stakeholder interviews.
5. Recommend how industry gaps can then be filled, resistance eased, and relationships formed, which promote timber in the Irish construction industry.

1.4 Research Rationale

Currently, the built environment is one of the culprits damaging the natural environment to a point where the planet is experiencing its sixth mass extinction (Rees, 2015). Having a policy-making mandate that is concerned with protecting the environment, I am drawn to promoting materials that have properties conducive to sustaining the planet shared by many.

1.5 Methodology

A qualitative methodology for the research is drawn from an ontological and epistemological relativist position. The literature is framed by two case study timber buildings, formulating the base knowledge from which field work and structured interview questions are designed. Fourth-generation evaluation married with discourse analysis findings aim to capture a deeper understanding of the forces limiting the role of timber in the Irish construction industry. Conclusions and a dissemination proposal are presented relative to the objectives and findings of the research question.

1.6 Document Structure

The dissertation structure as can be seen in Figure 2 includes.....

1. Research content and description of the research.
2. Formal mode of enquiry, describing the theoretical positioning and methodology used.
3. Literature review on the research topic.
4. Research methods utilised in the research.
5. Findings illustrated through a matrix diagram and discourse analysis of fourth generation evaluation interviews.
6. Conclusion of the study & dissemination mediums used.



Figure 2 Document Structure Diagram (Source: Image by F. N. Duffy)

CHAPTER 2

Theoretical Perspective & Research Methodology

2.1 Introduction

This chapter provides the reader with the theoretical positioning of the research and the methodologies used to conduct the study.

“The built environment is a major polluter. It matters how buildings are built and run, and it matters that environmentalism’s view of the world is adopted by all the participants in the building industry, architects included, as soon as possible. This puts a duty of care, not only on the profession, but also on the schools, for training future professionals” (Hagan, 2001, p. 193).

Chapter One outlines the background and aims of the research, which concerns the underutilisation of timber in the Irish construction industry, given its environmental properties. To focus the research, two case study buildings constructed 33 years apart were selected to frame the study. Policy, academy and procurement positions are found between the case study buildings literature review in Chapter 3.

Chapter Three further provides base information (Literature review) allowing methods of research through structured interviews and field work (Chapter Four), providing material for the discourse analysis (Chapter Five). The research dissemination in the form of an animation aims to fill a perceived gap in the education system (Chapter Six).

2.2 Ontological, Epistemological and Theoretical Position

2.2.1 Ontological Position

The research design is positioned in a constructed reality, taking a relativist stance over a realist ontology. This position holds that truth is relative to a person's historical and cultural experience.

2.2.2 Epistemological Position

The epistemological approach is emic, where truth is created. The research is qualitative, seeking subjectively to understand experience. The study identifies and analyses experience through the discourses collected, to find truths for the research question.

2.2.3 Theoretical Position

Theoretically the research has an environmentalist position, drawing on sustainability in the context of protecting the planet. Fifty-five years ago, the book *Silent Spring* (Rachel Carson, 1962) inspired a movement which has been building momentum through legislation measures attempting to preserve the delicate biosphere we occupy. For over 2,000 years, we have practiced a philosophy of Plato's *Timaeus*: "Man undermines and hacks at Nature. He opposes himself to her" (Le Corbusier, 1987, p. 24). Today we can see that we are part of nature, not separate from it and we have a moral obligation to maintain its wellbeing, as we are part of it (Sachs, 2016). Current building materials used in the construction of our built environment have rapacious energy requirements and emit climatic changing CO₂ emissions. Legislators and construction professionals have a moral obligation to protect the environment sustainably: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Hagan, 2001, p. 14).

2.3 Research Methodology

Research is generally divided into two types of data, which depend on the stance one takes regarding reality. Is truth a physical reality or is truth constructed in the mind? These positions are defined respectively as quantitative and qualitative. Quantitative data is measured or quantified using numbers, whereas qualitative is information about qualities which cannot be measured with numbers.

Each of these types of data has collection methods and outcomes.

Quantitative data is collected through structured research instruments:

- Large sample sizes representative of population
- The research can be replicated or repeated
- The research has a clearly defined question seeking objective answers
- The research is clearly defined at the beginning of the process

The data is illustrated with numbers and statistics, using tables and charts, questionnaires or computer software.

Qualitative data is collected through direct interaction with one or many individuals. individual interviews, focus groups, observations and action research

- It has smaller sample sizes, as the methods take longer, also making the process more expensive
- The information is richer, and greater insight into the research phenomenon.

This study uses a qualitative research methodology, analysing discourses collected from the literature review, action research and interviews, to gain answers for the research question.

2.4 Research Design

2.4.1 Primary

Primary research is defined as the original research carried out by the author of a study. The primary research in this study uses field work and a series of interviews, followed by an analysis of the discourse.

2.4.2 Secondary

Secondary research is the analysis and interpretation of primary research. The secondary research in this study is in Chapter Three, the literature review.

2.5 Data Collection

2.5.1 Literature Review

The literature review in Chapter Three is an objective critical summary of relevant published literature. The literature is framed by two exemplar timber buildings constructed between 1984 and 2017, examining policy, academy and procurement practices with respect to timber in the Irish construction sector. The framing and theming help to focus the literature. The review particularly seeks discourses that provide evidence of the underutilisation of timber, in order to realise practical solutions.

2.5.2 Action-based Research

2.5.2.1 Wood First Policy

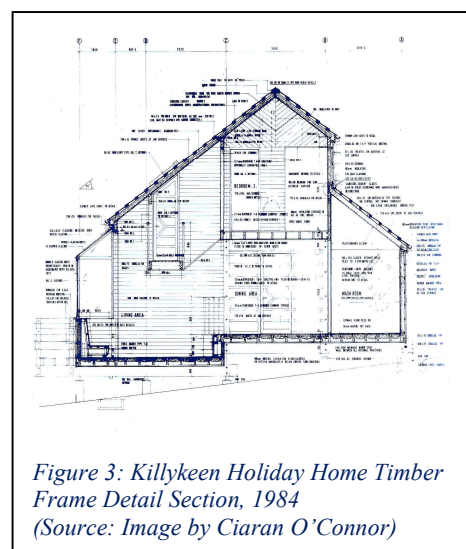
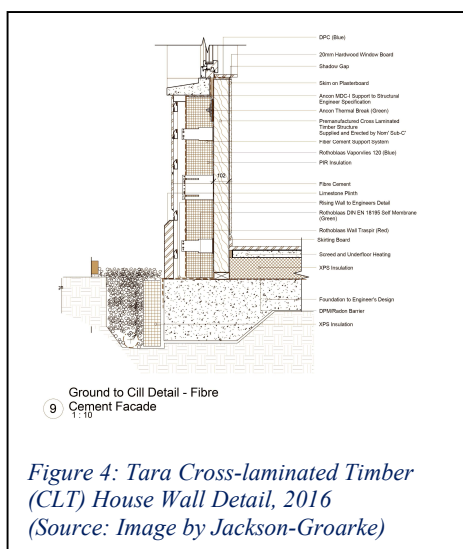
A significant aim of the research was to objectively support a “Wood First” policy motion in South Dublin County Council, seeking a local authority/state response and the passing of the motion into council policy (see section 4.2).

2.5.2.2 Parliamentary Question

The expert interview process revealed an anomaly with respect to why the State halted national afforestation. To clarify this anomaly, I actioned a parliamentary question which was submitted by Catherine Martin TD (see section 4.3).

2.5.3 Architectural Drawings

Two timber frame exemplar buildings were chosen as case studies for the literature review: Killykeen Holiday Homes, Co. Cavan, designed by the OPW (Office of Public Works) in 1984 and Jackson Groarke's 2017 cross-laminated timber house in Tara, Co. Meath. Both buildings illustrate construction methodologies relevant to the time in which they were built, and this can also be said for the other buildings illustrated in the research. These buildings reveal, through drawings, the technological and cultural knowledge available at the time of construction (see Chapter 4, Procurement).



2.5.4 Interviews

A two-stage expert/industry stakeholder interview process was designed with fourth-generation evaluation (Guba, & Lincoln, 1989), allowing for deeper discourse analysis of the research (Markus, & Cameron, 2002). This process is broken down in Chapter Four.

2.6 Discourse Analysis & Fourth-generation Evaluation

The research uses discourse analysis as prescribed in *The Words Between the Spaces* (Markus, & Cameron, 2002) to analyse the literature, “Wood First” motion, and interviews.

The research is analysed to find patterns, metaphors, and conducive and reformulating language in the discourse. This use of language illustrates constructed realities that hold particular positions of power in place. Fourth-generation evaluation is also actioned through the interviews. This responsive evaluation method affords equal weight to the opinions of all stakeholders and aims to reach a consensus of opinion, where possible, by bringing to the others the views of stakeholders for consideration.

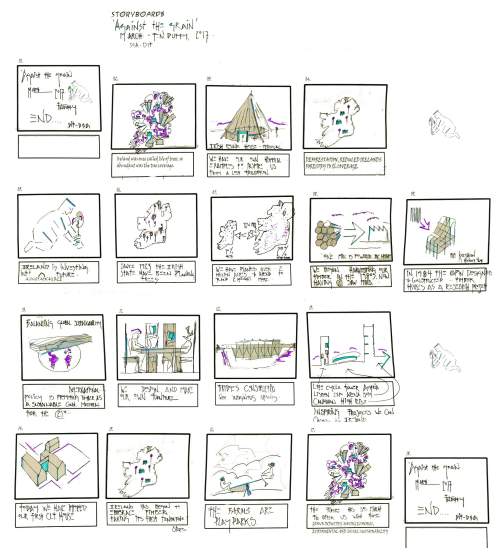


Figure 5: Dissemination Storyboard
(Source: Image by F. N. Duffy)

2.7 Dissemination

This research requires a formal dissemination medium to maximise its reach. Initial findings pointed to gaps in construction knowledge across the education system. A target audience, distribution mechanism, medium choice and funding make up the brief. The chosen medium includes a short whiteboard animation and poster for Transition Year students.

2.8 Ethical Considerations

Interviews for this research were conducted with prior approval from the DIT Research Ethics Committee (REC). Each participant was informed of the research topic objectives and given a verbal introduction to the research prior to the interview.

Consent forms were provided and signed at each interview, with the understanding that the data was confidential, and that consent would be sought by each interviewee prior to any publication. All interviewees were sincerely thanked for their participation and contribution to the research.

2.9 Research Limitations

As the M Arch programme is confined to a single academic year, the interviews were limited to a set number. The research literature was framed between the case study buildings 1984 to 2017, and themed on policy, academy and procurement.

2.10 Summary

This chapter provided the reader with the process, methods and design used to conduct the research. A qualitative methodology informs the methods used for the research, starting with a specific literature review to form the base of the study. Two-stage interviews, field work and drawings provide a discourse that is analysed to establish truth on the research. The findings direct the dissemination medium and further research requirements.

CHAPTER 3

Literature Review

3.1 Introduction

This research investigates the underutilisation of timber in the Irish construction industry, given its environmental properties. This chapter first discusses the historical legacy of the application of Irish timbers, and then examines two exemplar case study timber buildings that frame the literature in the field: Killykeen Holiday Homes in Co. Cavan, designed by the OPW in 1984, and a private CLT house in Tara, Co. Meath, by Jackson Groarke, 2017 (see Figs 6 and 7 below). This narrow focus allows an in-depth study, taking two buildings produced 33 years apart. The construction technology in place at the time of each case study is identified, as well as the philosophical perspectives; and an attempt is made to determine the extent to which this arc can be considered a continuous, progressive development, or an interrupted one.

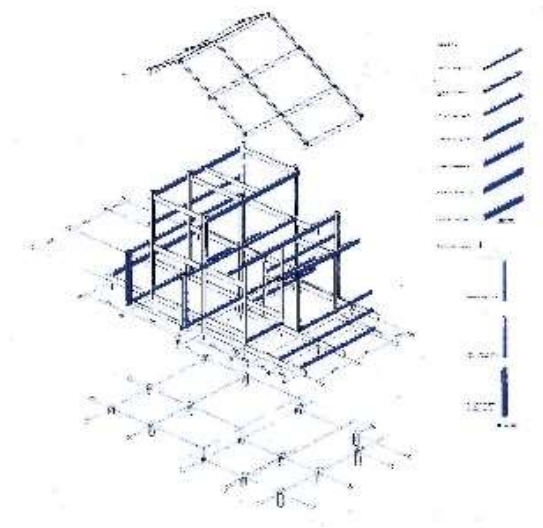


Figure 6: Killykeen Holiday Home Structural Frame, 1984 (Source: Image by Ciaran O'Connor)



S1-Key Section
1 : 200

Figure 7: Section of Tara Cross-laminated
Timber House, 2016

(Source: Image by Jackson-Groarke)

To this end, the studies concentrate on three areas that have proved significant in the development and progression of timber as a construction material: policy, academy and procurement. By assessing the relative states of each of these contributing areas represented by the case studies, I expect to pinpoint some of the weak and positive areas in the development of the construction industry.

3.2 Historical Legacy

Ireland's timber heritage predates policy and is founded on tradition. Contemporary policy implemented between the construction of the Killykeen and the Tara projects has evolved on a legacy of laws and environmental directives. However, to understand the recent context, one must first appreciate Ireland's historical legacy.

Ireland's early history had a rich heritage and relationship with timber, with early examples including the pre-Christian bardic name for Ireland, "Inis na bhfiodhbhaidth" or "Woody Island" (O'Carroll, 2004, p. 3). Early medieval roundhouses were constructed from hazel wood and oak, farmed in coppiced plantations (Kerr, Harney, Kinsella, O'Sullivan, & McCormick, 2009). Ireland's first alphabet, ogham, named its letters after native Irish trees, oak being the seventh consonant and ninth month of the ogham calendar; and in Irish folklore, oak represented strength, fertility, kingship and endurance (Mac Coitir, 2003).

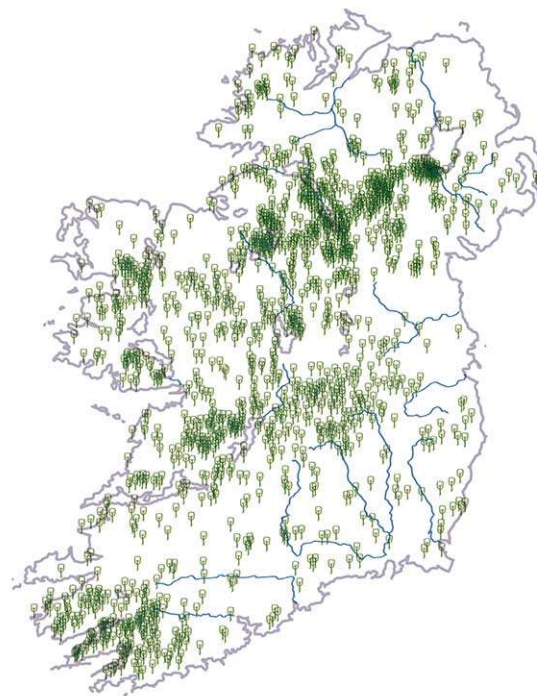


Figure 8: Map of Irish Townland Names, Including the Word "Oak" (Source: Image by F. N. Duffy)

Some 1,600 Irish townland names use the word “oak” in either the Irish translation of “dair”, or the anglicised word “derry”, Kildare being a common example (Fig. 8).

The 16th and 17th centuries saw many policy decisions that would affect Ireland’s timber construction culture for over 300 years. According to McCracken (1971, p. 75), the national plantation regime offered colonists enticements: “Each planter in 1610 was allotted 200 good oaks to make timber for such buildings as he wished to erect”.

During this period, the island had 12.5% forest coverage, which offered a generous supply of barrel staves (exported to France and Spain as wine casks), iron works charcoal and ship building timber for the English navy (McCracken, 1971, p. 39). In 1670, after the Great Fire of London (1666), the Lord Lieutenant decreed that all new Dublin houses were to be built of stone or brick, not timber. At the same time, Irish oak was being exported to rebuild London. Regrettably, these actions were coupled with weak political will to enforce reforestation laws (McCracken, 1971, p. 32); and only those who had independent means planted privately “*The most Striking thing on a first sight of the Irish landscape is the total absence of trees of any kind. They are only seen in private parks – Paschal Grousset, Irelands Disease, 1887*” Neeson (1990, p. 91).

These combined actions led to Ireland losing most of her forestry coverage (1% in 1923), and as a result timber had to be imported Scotland and further afield. The lack of this local material saw the eradication of timber construction expertise, creating a multi-generational loss of knowledge.

“The problem of deforestation is tragically eloquent of the evils of foreign rule in Ireland” (O’Carroll, cited Bulfin, 2004, p. 21). After 200 years of over exploitation and unsustainable forest management, the founding legislators of the Irish Republic inherited an

exhausted forestry, but sought to reforest Ireland starting from a standing position, planting 388 hectares in 1923. (O’Carroll, 2004).

In the same year that the Killykeen Holiday Homes were being constructed (1984), Sean McBride declared: “I think I can say that I have been keenly interested in the whole question of the reforestation of Ireland ever since my childhood days” (cited in O’Carroll, 2004, p. 22). As a result, in 1948 McBride as government minister initiated a Clan na Poblachta election promise to plant 1 million acres, as a reaction to the previous administration’s deforestation regime.



*Figure 9: Sean MacBride, 1948 Inter Party Government Minister
(Source: Image from <https://www.irishtimes.com/news/politics/archives-show-deference-of-se%C3%A1n-macbride-to-vatican-on-foreign-policy-1.2003101>)*

Over 400 years of policy saw Ireland go full circle from 12% to 1% and back to 12% forest cover only recently. Timber is seen as a luxury item in Ireland, partly due to its perceived relationship with British rule. Sean McBride saw the value of timber on its many levels for the wellbeing of a society, and now timber is being elevated internationally due to its environmental properties. The use of timber in the Irish construction industry is examined in the following case study section under policy, academy and procurement, as a means of seeking clarity on its position and momentum.

3.3 Procurement

3.3.1 Introduction

The first section of Chapter Three examines documented discourse around the role of timber in the Irish construction industry from the procurement perspective, again using the case study buildings to frame the research. Construction procurement today is a highly regulated, expensive and competitive arena, in which tradition is valued. Ireland has a conservative masonry building culture. This is due in part to costs, and legislating for change is challenging, considering the industry's lobbyists.

The Killykeen project was a prototype carried out by the State using construction technology that was typically seen in northern European countries, the USA and Canada. The State was able to afford the expertise, time and funding required to execute Killykeen, in order to illustrate the possibilities of native Irish timber using a hands-on craft material.

In the short period of time since the construction of Killykeen in 1984, timber construction has been revolutionised in part by the environmental need for sustainable materials, and because timber is now being manufactured akin to its counterpart materials, steel and concrete. The Tara CLT house is an example of one of the manufactured timber processes now being developed internationally, whereby off-site fabrication allows simple and fast assemblage on site.

3.3.2 Killykeen Timber Frame Holiday Homes

Afforestation state policy led by Sean McBride in 1948 (Fig. 9) found the Forest and Wildlife Service with a problem not encountered for some 300 years, as the roundwood harvest had quadrupled in three years from 1979 to 1982 (Fig. 15). With this new material coming on the market with higher quantities to follow, OPW architects, led by the Forest and Wildlife Service, saw a feasible opportunity: an R&D project designed to discover and display the potential of

Irish timber in the construction sector, using a post and beam timber frame construction methodology. Killykeen in Co. Cavan was selected as the site for holiday homes, located in a wood and lakeland setting. In-depth research was conducted into the Irish timber species available, and British Standards were a bench mark to aim for higher quality.

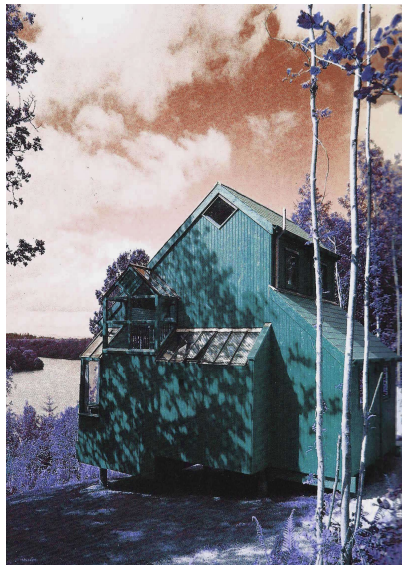


Figure 11: Killykeen Holiday Home Unit, 1984 (Source: Image by Ciaran O'Connor)

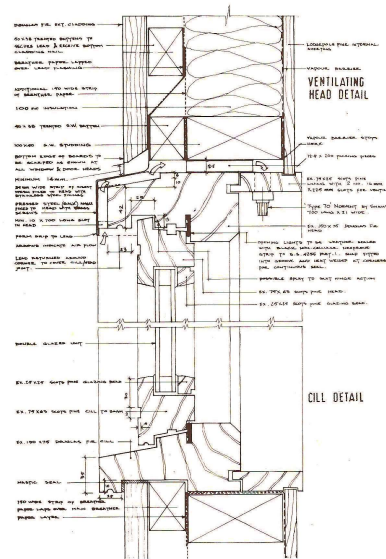


Figure 10: Killykeen Window Section Detail, 1984 (Source: Image by Ciaran O'Connor)

This exercise revealed the poor state of Ireland's timber industry, as Irish saw mills in 1984 were producing fencing products. Glennon Brothers were engaged to procure the timber and were required to work to tolerances of 0.5mm over the norm of 5mm worked to then (0.5mm being a furniture tolerance). This required second machining. The second issue was the lack of drying facilities in Irish saw mills, which meant that the wood for Killykeen had to be transported to Kill in Kildare for drying. Further concerns were expressed when a UK timber frame housing project failed in a manner that led to buildings being condemned. The Killykeen architects mitigated this issue by having coherent annotated designs and a rigorous

procurement management process. This strategy concurred with architect Greg Jackson's approach to the design of the second case study: the CLT building in Tara, Co. Meath.

3.3.3 Cross-laminated Timber (CLT) House in Tara

The CLT house designed by Jackson + Groarke in Tara, Co. Meath, is a private project which began construction in 2017. The project relied heavily on international expertise from London and Austria, thus proving difficult to make a direct development connection from the Killykeen Holiday Homes. The architect and client had an opportunity to design a building using a digitally fabricated, carbon neutral, solid CLT timber structure – the first of its kind in Ireland. This type of project requires meticulous pre-planning, to ensure the accuracy of the CNC cut components, and which allows for swift and efficient construction on site (Jacksonsgroarke.com). The CLT timber frame had a five-day erection time, ensuring that the project was sealed within two weeks, and the material was cost neutral, compared to masonry procurement.

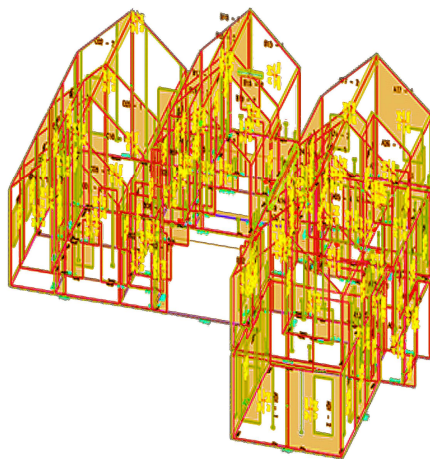


Figure 12: Tara CLT Fabrication Drawing, 2016 (Source: Image by Jackson-Groarke)



Figure 13: View of Onsite CLT Erection at Tara, 2017 (Source: Image by Jackson-Groarke)

The expertise for the design and construction of the project was gained by the architects attending training in London and from the Austrian CLT manufacturer. *Woodspec: A Guide to Designing, Detailing and Specifying Timber in Ireland* (O'Connor, 2001) was referenced for the project, but did not provide design details commensurate with the project's intentions. The design team consulted Dr Annette M. Harte of NUIG, given her ongoing research into the viability of using native Irish Sitka spruce grade C16 for CLT production. To this end, Dr Harte assisted Jackson + Groarke through introductions to Irish contractors who were experienced CLT fabricators. This, in turn, gave Dr Harte direct exposure to a live CLT construction project. The project imported the manufactured timber from Austrian forest wood, which infers that the project does not reflect Ireland's current roundwood harvest.

3.3.4 National Procurement

Ireland has experienced an evolving revival of timber use in the construction industry during the time that has elapsed between the two case study buildings. This section explores the momentum and resistance. Killykeen was an exercise in using native Irish timber, employing traditional hands-on craft technology for construction, and at the same time making use of international best practice construction techniques (American and Scandinavian). This methodology was one which honoured traditional construction techniques, incorporating Irish regulations. The technique used dried and preserved sawn logs to assemble a timber frame system. Today, this system is redundant with respect to modern timber fabrication systems, where the timber is fabricated in factory conditions, into wall, floor and roof components. This is in contrast with Killykeen, which was fabricated on site from milled planks.

One of the first companies to come to the market with off-site fabricated timber frames was Century Homes, established in 1990. In 2002, Coillte formed a partnership with Griffner, a Scandinavian timber frame company, to produce high-end timber frame dwellings for the Irish market. This enterprise collapsed in 2007, with the onset of the economic recession, but

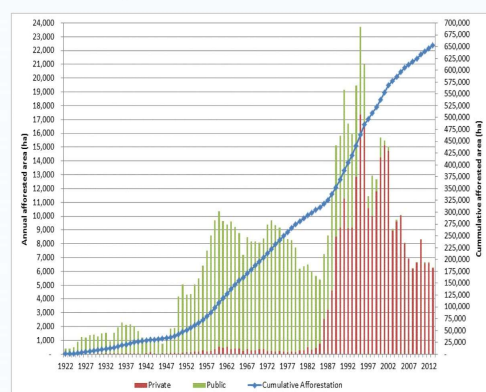
Century Homes worked through the recession, now part of the Kingspan group. Today, Kingspan continues to manufacture timber frame homes and develops its product to meet national building regulation obligations. The 2017 Part B domestic fire safety standard was very quickly resolved by the manufacturers developing timber frame components that met the fire obligations. This mitigated the design responsibility risk away from the architect, allowing the security that the building is Part B compliant, with a solution created by the manufacturer. This example of standardisation of timber in construction allows timber to compete with steel and concrete.

Policy-driven building regulations for social good, to protect the environment, are seeing the emergence of a new paradigm, where environmental systems are being folded into contemporary architecture (Hagan, 2001). The Tara CLT house has a vernacular form, while constructed from a 21st-century manufactured timber system imported from Austria.

Both case studies showcase timber buildings, but local authorities are proscribing masonry construction. In 2017, SDCC tendered for council housing with a masonry design that conflicted with national green procurement policy (GPP) commitments, whereby local government is tasked with setting the sustainable example to the public.

This resistance – whether through vested interests or lack of construction knowledge – sends out mixed messages. It was illustrated in the official response by the State to the “Wood First” motion by South Dublin County Council, citing fire, moisture and structural issues, that research proves are not fait accompli (Table 5). A further anomaly lies in COFORD’s (Council for Forest Research and Development’s) *Growing the Irish Forest Bioeconomy* report (2017), which includes CLT production opportunities. Here, two arms of the State that disagree with each other.

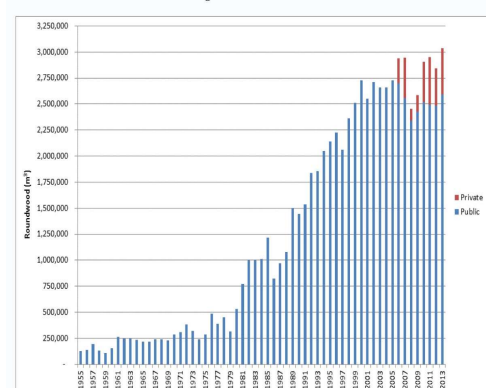
Private afforestation came to the fore in the mid-80s following the introduction of a grant and particularly an annual premium scheme for afforestation. Long-run afforestation trends, including the change from state-led to private-led grant-aided afforestation in the 1980s and 1990s, are shown in Figure 5.



Annual state and private afforestation 1922-2013.

Figure 14: Annual State & Private Afforestation 1922-2013, DATI – Annual Forest Sector Statistics, 2014 (Source: Image from COFORD Report)

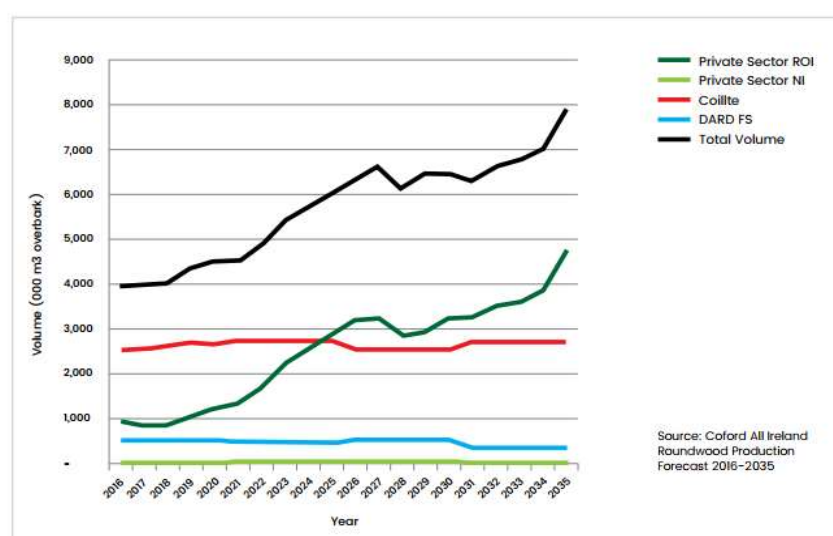
Up until the early eighties roundwood harvest was low, due to relatively low afforestation rates up to 1950. The early 80s saw the opening of the Finsa and Medite board mills which drove up demand for roundwood and sawmilling residues.



Roundwood harvest 1955-2013.

Figure 15: As Above

Figures illustrating the State's afforestation policy, showing: the 1948 policy implementation of planting (Fig. 14); the spike in roundwood harvesting in 1984 (Killykeen); (Fig. 15); and the roundwood forecast showing our current output doubling (Fig. 16). Fig. 16 also highlights that Ireland will be harvesting a large quantity of timber in 2035, which, with management and knowledge, could supply Ireland's construction industry with suitable grade timber.



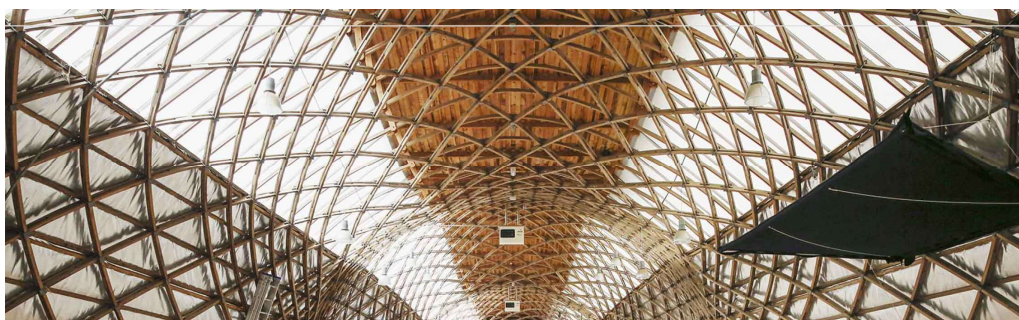
Source: Coford All Ireland Roundwood Production Forecast 2016-2035

Figure 16: Coford all Ireland Roundwood Production Forecast, 2016-2035 (Source: Image from COFORD Report)

3.3.5 International Procurement

Internationally, timber is being analysed for construction procurement, on account of its environmental properties. Contemporary environmental protection policy and legislation are demanding lower energy and waste outcomes from materials. Bio-renewable building materials (BBM's), predominately timber, were recognised as being relevant in December 2011 at the UN Framework Convention on Climate Change (UNFCCC). These materials absorb carbon by photosynthesis, or lowering the concentration of carbon dioxide in the atmosphere, and the material becomes a sink or reservoir for carbon, coined “carbon Sequestration by Buildings” (Sadler, & Robson, 2013).

Wales has been experiencing a timber renaissance akin to Ireland, where a masonry construction culture has dominated for centuries. Many factors have contributed to this, including international policy's promotion of sustainable construction practice. However, technology has also played its part in prefabrication and efficient construction techniques. The unbroken timber construction traditions of Europe, Japan and North America have also assisted, decoupling from tradition to find new engineered solutions without imitation. Edward Cullinan has been at the forefront of this evolution, with his architecture creating solutions that combine craft and engineering with local materials (Coombs, 2015).



*Figure 17: Edward Cullinan Gridshell Weald and Downland Open Air Museum in Sussex.
(Source: Image from <http://cullinanstudio.com/project/downland-gridshell>)*

Research into existing procurement practices has yielded significant data that illustrates timber's unique sustainable properties, including life cycle assessment (LCA), local material selection, longevity, erection times, CO₂ emissions, and embodied energy. These properties indicate that timber holds advantages and parity with its counterpart materials of steel and concrete (see Table 1).

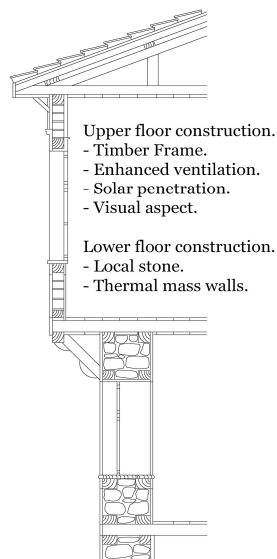


Figure 19: Florina Domestic Bioclimatic Functional Design Section – circa 1850.
(Source: Image by F. N. Duffy)

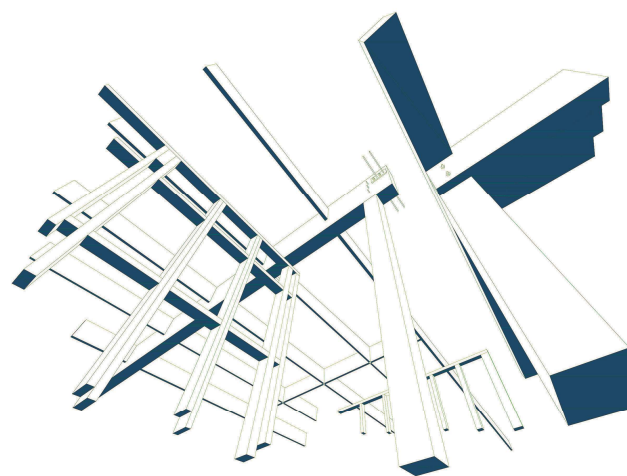


Figure 18 Library at the dock Melbourne CLT structural perspective. Australia's Green Building Council first six-star green star as built building 2014.
(Source: Image by F. N. Duffy)

Table 1 Procurement Advantages of Timber Construction
(Table compiled for this research by F. N. Duffy)

PROPERTY	AUTHOR & DATE	DESCRIPTION
LCA (Life Cycle Analysis)	Higham, Fortune and James (2015)	LCA of building materials has been proved to reduce energy costs and CO ₂ emissions, thus reducing the environmental impact of building procurement. A UK study highlights a lack of education, regulation and stimulus for practitioners. It was found that the only practitioners committed to LCA were those procuring state work, and many of the positive elements incorporated into a project relative to LCA are removed when the project is value engineered. Therefore, most modern construction projects do not receive any

		benefits from LCA, as the costs are a disincentive in the initial phases of procurement.
Material Selection	Hammond, and Jones (2008); Takano, Hughes, and Winter (2014); Morel, Mesbah, Oggero, and Walker (2001)	Material selection is an important part of the design process, and sourcing locally contributes to the sustainability of our built environment. However, this process is all too often overlooked in the early stages of architectural procurement. Buildings consume 8% of UK's energy, through transportation and production, and using local materials over concrete further reduces the energy requirement by up to 215% and transportation by 453%. Extrapolated into a lower population density implies a greater consumption by Ireland. While comparative statistics are not available, the SEAI (Sustainable Energy Authority of Ireland) energy in transport report (2014) identifies that road freight alone accounted for 8.4 % of Irelands final energy consumption in 2013, and this was down 49% in 2007, due to the recession.
Longevity	Chappell (1983); Harris (1982)	Timber buildings in use today, relative to bricks and mortar, have similar lifespans in real terms. Longevity of medieval Scandinavian 8 th -century stave churches demonstrates the life span of timber construction. Bridges and Tudor frame dwellings also stand up to time.
Embodied Energy & High Rise	Kaufmann, and Strauch (2012)	The "life cycle tower" prototype is a timber hybrid tower developed and constructed in Dornbirn, Austria. The purpose of the project was to seek a timber construction system, analysing the feasibility of high-rise timber building for the European market, testing fire standards, durability, non-toxic materials, shorter construction times, cost, energy efficiency and high-quality timber finishes – all factors being tested through the German Sustainable Building Council criteria. The life cycle tower prototype was specifically undertaken to prove the value of timber. Other countries construct tall timber buildings, with Canada having claim to the highest today at 18 storeys. Brock Commons Tallwood House, the recently completed student residence building at the University of British Columbia (UBC) in Vancouver, now occupies a prominent position within architecture: the tallest building with a timber structure in the world.

Bioclimatic functional Design	Oikonomou, and Bougiatioti (2011)	The late 19 th -century dwellings in Florina, north western Greece, have conservative and selective modes of environmental management incorporated throughout the buildings, designed to harness the environmental conditions (Banham, 1969). The building designers analysed the town's typology, required form, local materials, construction techniques, bioclimatic comfort conditions, thermal behaviour, and visual comfort. The homes follow the valley river, and all have similar attributes where the form and materials of the buildings are designed to take advantage of the immediate environmental conditions, with low-cost materials available locally. Instead of buying in industrial materials with added transport costs, stone was sourced from the river and utilised at ground-floor level for its durability and thermal mass qualities. The upper floors were constructed in local timber, allowing for a lighter external fabric. This configuration of local materials creates a bioclimatic functional design. Where the ground floor's reduced window openings and thermal mass walls were predominantly used in the winter, the upper floors were utilised in the summer months, to take advantage of the prevailing wind's cooling action (Fig. 18). The architecture of Florina is also characterised by the building's southern or eastern orientation, thus enhancing ventilation and solar exposure.
CLT (Cross laminated timber)	Make it Wood, (2014)	The example of the library at the Docks in Melbourne, Australia, illustrates Bio-renewable building materials (BBM) utilisation of timber, where the designers have incorporated CLT and recycled hardwood. The building's façade is made up of recycled Ironbark and Tallowwood timber, blending into the existing Victoria Harbour South Wharf. The architect used CLT for the building's structure, as it has the same characteristics as concrete. It is an engineered timber construction system, with high strength and dimensional stability, and can be used as an alternative to concrete and steel. The library is an active reservoir storing circa 250 tonnes of carbon in its timber components. The structure is also 30% lighter than traditional building systems, thus reducing cost. The building is also naturally ventilated and utilises daylight, further reducing energy consumption and CO ₂ emissions.
Wood Structure	Hill (2014)	Shigeru Ban's has an international reputation for designing in timber, coming from a Japanese timber culture. The seven-story Tamedia office building in Zürich, brings timber technology to another level. The

		complete timber structure is prefabricated using CNC milling machines and does not use any metal connections, instead utilising beach at junctions due to its strength.
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International research, as summarised in Table 3, illustrates that timber is a sustainable procurement material for the construction sector. However, it will have to earn its market share, as other materials are not rolling over easily, and research is being produced which claiming equivalent sustainable credentials and takes issue with the timber industry using sustainability as a route to get market share (Xi, 2016; Peng, 2013).

3.3.6 Summary

This section of the chapter investigated the role of timber in the Irish construction industry with respect to procurement. Ireland's limited relationship with timber for over 300 years has resulted in a masonry-dominated construction culture. However, over the 33-year period between the procurement of these case studies, the construction industry has become highly regulated, and environmental concerns are evolving through the policy and legislative structure, thus placing environmental obligations on the procurement process.

Killykeen was a prototype timber building, born out of a 1948-quasi-environmental policy by Sean McBride in the Inter Party Government to re-establish Ireland's forestry and its benefits. The project was initially an intelligence-seeking exercise, as the 1948 roundwood was beginning to be harvested. Killykeen, therefore, could be seen as an initial investment in native Irish construction timber by the State. Further investment, including the establishment of Coillte, Teagasc and COFORD, came to manage and promote the potential of the resource. The environmental movement has and will continue to frame international legislation, and countries with timber construction cultures are engaging through ground-breaking multi-storey timber procurement projects. Ireland has been slow to pick up on this, citing structural issues, climatic

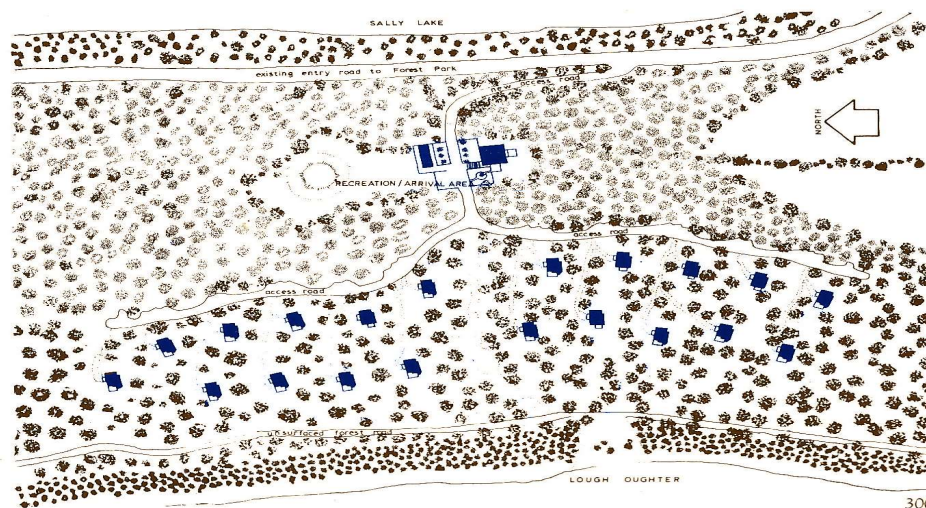
and fire reasons for the inertia, although some timber is being utilised in a number of buildings nationwide by designers willing to take on the Irish regulation challenges put before them.

The CLT house in Tara is the first CLT of its kind. However, both the architect and researcher Dr Harte would argue that CLT's primary remit is for high-rise structures, though regulation currently prohibits high-rise timber in Ireland. While procurement of timber buildings in Ireland is gradual, there is momentum, and both the industry and State are developing timber as a construction material.

3.4 Policy

3.4.1 Introduction

Construction policy today is heavily influenced by environmental concerns, with most western societies having advanced environmental movements advancing legislation that endeavours to protect the biosphere (Hagan, 2001). This section investigates policy document discourse between the case study buildings. Both national and international contexts are considered, with the intention to seek discourses working for and against the advancement of timber as a material in the Irish construction industry.



*Figure 20: Killykeen Forest Park Holiday Homes, Co. Cavan. 1984
(Source: Image by Ciaran O'Connor)*

3.4.2 National Policy

This section explores Ireland's policy positions that affect timbers procurement. Both case study buildings are exemplar timber constructions in Ireland, indirectly resulting from state policy. Killykeen was a state-sponsored project as a result afforestation policy in 1948 and the Tara project was led mainly by international technology and experience, but also drew on *Woodspec* (O'Connor, 2001) and Dr Harte, both funded by the State.

Table 2 was collated for this research to illustrate national policy that affects the role of timber in the Irish construction industry. Many of the policies play a part in the evolution of the utilisation of timber through state organisations, from forest management training in Teagasc to NUIG research into high-rise CLT buildings. This is because timber has a positive CO₂ impact, which can reduce the construction industry's CO₂ emissions

Also within Table 2 are policies using sustainable language, including Green Tenders 2011, Sustainable Future 2012 and Construction Strategy 2014. According to Phil Hogan, Minister of Environment Community and Local Government (Sustainable Future, 2012, Foreword, p. 5), “Decoupling environmental degradation and resource consumption from economic and social development is an enduring challenge in Ireland and requires a paradigm shift in our approach to future development”. These policies outline a sustainable vision covering environment, economy and society, but there is a contradiction. The construction industry is one of the largest contributors of CO₂ emissions (Akan, Dhavale, & Sarkis, 2017), but this significant issue is overlooked in these policies. This issue is compounded firstly by the fact that the national GPP (Green Procurement Policy) has not been published (the EU's 2008 GPP obliges all EU public authorities to lead the way through their own sustainable procurement practices, with a view to shaping public perception). Secondly, the Building Regulations Part D (Materials & Workmanship, 2013) does not consider the embodied energy of materials. In Holland, the legislature and construction industry are developing a system that monetises environmental performance of a construction project (European Commission, 2013). This model has potential in the Irish context. In order for this to happen, the State needs to legislate in a similar way to Part L, which has effectively eliminated energy requirements in domestic homes. Architects and engineers work to comply with building regulations.

National policy shows two sides within the State: one which is empowering the timber industry and the other which illustrates resistance through rhetorical policy. Phil Hogan refers to a

paradigm shift that is required, and the majority of policies shows this is happening, albeit at a generational pace.

Table 2 Construction-related Policy Affecting the Development of Timber in Ireland
(Table compiled for this research by F. N. Duffy)

DEPARTMENT	POLICY TITLE & DATE	POLICY SUMMARY/IMPORTANCE
Lands	1948 <i>White Paper</i>	Afforestation of 1 million acres of forestry. A white paper proposed by Clann na Poblachta's Séan MacBride, Minister for External Affairs. The paper sets out the government's intentions under the post-war European Recovery Programme known as the Marshall Plan. The approved programme set about planting 25,000 acres per annum, to reach 1 million acres in 40 years. (O'Carroll, 2004)
EU	1981 Western Package Scheme	The Western Package Scheme, co-funded by the EU and the Irish government, was introduced to provide grant aid to farmers for planting marginal agricultural land. This was followed by a series of other packages aimed at encouraging further private involvement. These, together with CAP reform, increased private planting from 5% of total planting in 1984 to 73% in 1995, effectively reversing the domination of the National Afforestation Programme by the State. (O'Carroll, 2004)
OPW and the National Parks & Wildlife Service	1984	Design and construction of Killykeen Holiday Homes, Co. Cavan.
Agriculture	1988 Forestry Act	Establishment of Coillte. Coillte was established as a commercial company by the State, with the purpose of managing Ireland's state forestry in an innovative and sustainable manner. The company owns circa 1 million acres (7% of the country's land), employing approximately 1,000 people (Coillte, 2017). While Coillte has a remit to manage Ireland's forestry and renewable energy, it is obliged to serve its citizens through recreational facilities, parks and protection of the biodiversity of the ecosystem it owns on behalf of the State. The forestry industry in Ireland amounts to circa 2% of the economy. A further €367m worth of annual economic activity can be attributed to Ireland's forestry thorough separate studies by Coillte, the Heritage Council and the Irish Sports Council, with respect to recreation activities. Water purification, soil erosion and carbon sequestration can also be attributed to Coillte's contribution to Ireland's wellbeing (Donlan, Skog, & Byrne, 2012). The sale of Coillte nearly came to pass, a potentially detrimental action, whereby the State considered selling 1 million acres (circa 7% of its land

		mass) to the highest bidder, as part of the enforced EU/IMF programme. This was diluted into leasing the land and its harvest for 80 years for a paltry sum of €0.5 billion. Peter Bacon & Associates produced a report with respect to the potential consequences of such a transaction in 2013, and insisted that the economic rationale did not stand up and could not be justified. The Bacon report and public pressure ensured that Coillte was neither sold nor leased.
Agriculture	1988 Teagasc Agriculture (Research, Training and Advice) Act	Established in 1988, Teagasc has a strong role in the forestry sector, with responsibility for the provision of research, training and advisory services.
Agriculture	1993 COFORD National Development Plan	COFORD was established by the Government (Minister of State for Forestry) and is responsible for forestry research and development in Ireland, aiming to strengthen links between industry and research. COFORD's R&D practice is multifunctional, looking into international competitiveness and systems to enhance the procurement of timber sustainably, while being cost effective; sustainable employment through native wood products; harvesting and transport industry innovation, and environmental protection and enhancement via techniques, ensuring biodiversity in existing ecosystems. COFORD analyses the impact of afforestation programmes on rural development, seeking proof of purpose in economic and community security, through farm forestry, while complying with environmental harmony. <i>Woodspec</i> (O'Connor, 2001) was produced by COFORD as a technical guide/specification manual for the building industry. It highlights how state initiatives have built up our national land coverage from 1% to 10% over the past 100 years. Policy prohibited use of agricultural land where the State was involved, and this has limited the species that can be grown, which means that broadleaf stock is low, compared to soft woods that are now the mainstay of Irish forestry (currently 20%, aiming for 30%).
Irish State	1996 Growing for the Future	The Government published <i>Growing for the Future</i> , outlining a strategic plan for the development of the forestry sector well into the next century. Objectives involved more emphasis on the multi-benefit aspects of forests, and increased species diversity, including broadleaves.
Agriculture	2001 <i>Woodspec</i> published under COFORD	<i>Woodspec: Guide to Designing, Detailing and Specifying Timber in Ireland</i> . Author, OPW State Architect Ciaran O'Connor, who incidentally designed the Killykeen Holiday Homes and is presiding over the procurement of the national GPP.
Environment	2003 <i>Timber Frame Housing Report</i>	This government report carries out a detailed examination of 2002 practices and procedures in relation to the use of timber frame construction for private sector and social housing in Ireland. Recommendations: - To assess the impact of the current regulatory regime and related technical requirements on the provision of timber

		<p>frame housing, and recommend any appropriate amendments to regulations, guidance or practice;</p> <ul style="list-style-type: none"> - To assess current systems and practices in relation to quality control and product certification in timber frame housing construction at all stages up to the completed dwelling, and recommend any appropriate improvements in procedures and practices; - The timber frame industry should fund the development of a comprehensive suite of educational material on timber frame construction and, in partnership with FÁS, etc. Material to be at a level appropriate for complete range of construction disciplines: - Students of architecture, engineering, construction and surveying; - Architects, engineers, surveyors, and other professionals and surveyors; - Timber frame designers; - Manufacturing staff; - Erectors; - Follow-on trades (e.g. plumbers, electrician, bricklayers, dry-liners; - Site managers; - Clerks of works. <p>The TFHC concluded that timber frame construction systems consisting of factory-manufactured timber panels, assembled on site as a kit and completed by the installation of the work of following trades, was a suitable form of construction for housing in Ireland.</p>
Environment	2011	Draft National Action Plan on GPP. The 2011 GPP Draft National Action Plan sought to achieve a gradual transition to a low carbon, competitive, climate-resilient economy, but the document only asked for the Irish public sector to be mindful of EU and international developments in “life cycle analysis”.
Environment	2012 Towards Nearly Zero Energy Buildings In Ireland	<p>TOWARDS NEARLY ZERO ENERGY BUILDINGS (NZEB) IN IRELAND</p> <p>‘Energy use and CO2 emissions associated with the built environment continue to be significant and measures to reduce their impact in both new and existing buildings will continue to be an important component of Government energy and climate change policies’, ‘Against this background, improvements in energy efficiency within the buildings sector in tandem with the increased use of renewable energy technologies constitute important policy measures needed to facilitate a reduction in Ireland’s energy dependency on fossil fuels and associated greenhouse gas emissions over the period to 2020 and beyond’.</p>
Environment	2012 National Climate Change	The <i>National Climate Change Adaptation Framework</i> provides a strategic policy focus to ensure adaptation measures are taken across different sectors and levels of Government to reduce Ireland’s vulnerability to the negative impacts of climate change.

Environment	2013 Building Regulations	<p>Part D – Materials & Workmanship (2013)</p> <p>The Building Regulation TGD on Material (Part D) is one of the shortest guidance documents, giving only two pages to cover construction materials. While Ireland has policies promoting sustainability, the construction sector is de facto governed by national building standards (TGD's).</p> <p>Part D states: "All works to which these Regulations apply shall be carried out with proper materials and in a workmanlike manner".</p> <p>Definition: "proper materials" means materials which are fit for the use for which they are intended and for the conditions in which they are to be used, and includes materials which:</p> <ul style="list-style-type: none"> (a) bear a CE Marking in accordance with the provisions of the Construction Products Regulation; (b) comply with an appropriate harmonised standard or European Technical Assessment in accordance with the provisions of the Construction Products Regulation; or (c) comply with an appropriate Irish Standard or Irish Agrément Certificate or with an alternative national technical specification of any State which is a contracting party to the Agreement on the European Economic Area, which provides in use an equivalent level of safety and suitability.
Government	2013 Harvesting Rights	<p>Sale of the harvesting rights for the country's state-owned forests, abandoned.</p> <p>(Bacon, 2013)</p>
Agriculture	2014 Forestry Act	<p>Forestry Act 2014</p> <p>An Act to make further and better provision in relation to forestry, to provide for the development and promotion of forestry in a manner that maximises the economic, environmental and social value of forests within the principles of sustainable forest management.</p>
Agriculture	2015 Wood Technology Ireland	<p>"Wood technology Ireland (WTI) has been established to provide the Irish timber and construction industry with technical advice and information to facilitate compliance with standard specifications, the construction products regulations (CPR) and the requirements of the Irish building regulations. WTI can liaise with government, industry and technical bodies for the benefit of Irish companies and timber users. WTI will support and help to develop training and education initiatives. WTI's activities are part funded through grant aid provided by the Department of Agriculture, Food and the Marine (DAFM)."</p> <p>http://www.woodtechnologyireland.ie/docs/WTI%20Flyer%20April%2016%20v3.pdf</p>

SDCC	2017 “Wood First” Motion	<p>“Wood First” passed.</p> <p>“That this Council adopts a ‘Wood First Policy’ to facilitate a culture of wood, by requiring the use of wood as the primary building material where practical in all new and modified South Dublin County Council funded buildings. In a manner consistent with the Irish Building Regulations and National/EU sustainability policy objectives that substantially reduce embodied energy and CO₂ emissions, which in turn protect our environment. Similar policies exist across the globe, some include the Wood First Act in British Columbia, Japan’s Law No. 36 of 2010 promoting the use of Wood materials for Public Buildings, and closer to home in 2012 Hackney in London became the first Local Authority to promote timber construction in its planning policy”.</p>
Agriculture	2017 “Talking Timber”	<p>Minister’s address to Teagasc: “Talking Timber”. Andrew Doyle, the Junior Minister for State with responsibility for forestry, acknowledged the state’s investment:</p> <p>“Production, if properly managed, can make a huge contribution to the local economies of rural communities throughout Ireland. It is appropriate, therefore, that we invest in the development of the skills and technical support necessary to ensure that we utilize that resource fully and sustainably”.</p>
Agriculture	2017 Discussion Paper	Discussion paper by Harte and Hendrik – High-rise timber structures.
Environment	?	<p>Ireland’s National Green Procurement Policy (GPP)</p> <p>This document is obliged to follow the EU 2008 GPP policy, however Ireland’s publication of this policy document has delayed by vested interests.</p>
Environment	2012 Sustainable Future Policy	<p>Sustainable Future Policy.</p> <p>Foreword by An Taoiseach, Enda Kenny, T.D.</p> <p>“Our Sustainable Future is ambitious in both scope and intent. It sets out a medium to long-term framework for advancing sustainable development and the green economy in Ireland.”</p>
Environment	2012 Green Tenders	<p>Green Tenders, an Action Plan on Green Public Procurement.</p> <p>“Green Tenders, an Action Plan on Green Public Procurement, is the first such Action Plan to be introduced in Ireland. Its overall objective is to assist public authorities to successfully plan and implement green public procurement (GPP) by highlighting existing best-practice and outlining further actions to boost green public procurement”.</p> <p>Forward by Brendan Howlin, TD Minister for Public Expenditure and Reform Phil Hogan, TD Minister for the Environment, Community and Local Government.</p>

Government	2014 Construction Strategy 2020	<p>Construction Strategy, 2020.</p> <p>“Ireland needs a strong and sustainable construction sector.”</p> <p>“In this Strategy we have set out a focussed programme of action to deliver a strong, sustainable, well-financed, competitive and innovative approach to construction and housing, building to the highest standards, at realistic levels and with consumer protection at its heart.”</p> <p>Forward extract by Enda Kenny T.D. Taoiseach Eamon Gilmore T.D. Tánaiste</p>
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3.4.3 International Policy

The ideas influencing Killykeen could be compared to contemporary international policy positions prescribing sustainable timber technologies, production methodology and social rationale, with a view to reducing CO₂ emissions and energy use, and to increasing sustainable employment (see Table 3.3). Killykeen may appear to have been ahead of its time, but in fact it was the fruition of afforestation state policy, where roundwood was for the first time being harvested. This offered an opportunity to use natively grown timber for the first time in the State's history to foresee future potential of the material in a post and beam construction methodology.

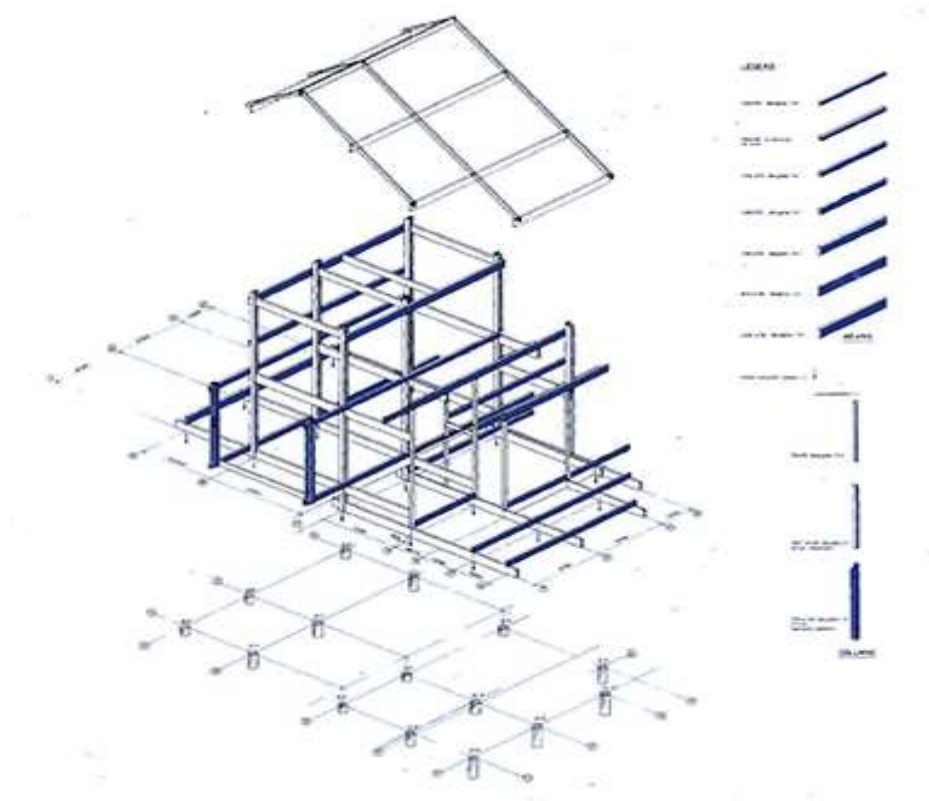


Figure 21: Killykeen Post and Beam Timber Frame Axonometric, 1984
(Source: Image by Ciaran O'Connor)

Internationally, in 2017 timber is viewed as one of the environmental solutions to climate change (Table 1), where technology has developed allowing multi-storey timber buildings to be constructed in many cities around the world (Kaufmann, & Strauch, 2012). These buildings

are informing public policy and legislation which, in turn, are reforming the construction industry by folding environmental technology into architecture (Hagan, 2001). The Dutch legislature and construction industry are developing an LCA system for state tenders that uses environmental product declarations (EPDs) and environmental cost indicators (ECI's). This system monetises environmental performance of construction materials at the tender stage, mitigating environmental damage (UK Green Building Council (UKGBC), 2014).

The architect of the second case study, the CLT house in Tara, Co. Meath, found the national technical knowledge limited, and had to seek international experience and technology solutions in London and Austria to procure the project.

Akin to national policy, momentum to legislate for timber is illustrated internationally (Table 3), but again a contradiction exists. EU GPP policy in 2008 (Table 3) obliges all local authorities to adopt sustainable procurement practices throughout their organisations, with a view to informing the public perception. However, in the 2017 EU Action Plan for Sustainability (Table 3), the construction industry does not appear in the document. Considering that the built environment is a considerable CO₂ emitter and energy consumer, it is perturbing that objectives are excluded from mitigating environmental damage. This conflict implies differing forces at work in the policy-making arena, and is also evident in both the action research and interview methods reported on in Chapter Four.

Table 3 International Policy Adopted to Promote Timber in the Construction Industry
(Table compiled for this research by F. N. Duffy)

COUNTRY	AUTHORITY	POLICY TITLE/DATE	POLICY SUMMARY
EU	All EU States	1995 Eurocode 5 (IS EN 1995-1-1)	<i>Design of Timber Structures – Part 1-1: General – Common Rules and Rules for Buildings</i> was published by

			CEN (European Committee for Standardisation) in November 2004.
EU	All EU States	2008 <i>Public Procurement for a Better Environment</i>	<p>GPP obliges EU public authorities to lead the way through their own sustainable procurement practices, with a view to shaping public perception (as local authorities spend 16% of the EU's GDP). Therefore, realising the benefits of green procurement, and increasing the demand for same, it enlarges the market for environmentally friendly goods and services.</p> <p>The EU has an extensive input, including its Forestry Strategy Policy, which sets out a legal framework, common state objectives and guiding principles with respect to long-term competitiveness, environmental protection, quality of life, and member state coordination (Commission Staff Working Document 2013) (<i>The EU Forest Action Plan (FAP)</i>).</p>
Japan	National	2010 Law No. 36	Japanese legislation (2010, Law No. 36) promotes timber use in public buildings (both structural and decorative). It also has national promotional initiatives in education through “ <i>Kizukai</i> ” (attention to wood use) and “ <i>Mokuiku</i> ” (wood use education). All government ministries, prefectures and two-thirds of their municipalities have developed wood use policies (Forestry Agency, 2012).
UK	National	2011 Carbon Plan	<p>Following on from EU policy, the UK Government has engaged in carbon-neutral investment and departmental-assigned carbon budgets respectively.</p> <p>The ICE's (Institute of Civil Engineer's) briefing on British timber in construction forecasts a future where the UK can take advantage of its only renewable construction resource, by promoting new employment through skilled workforce and industries (Smith, 2015). TRADA (Timber Research and Development Association) in the UK</p>

			<p>provides information on timber and wood products scientifically, showing the benefits that timber can provide.</p> <p>They articulate that timber comes from a living tree, therefore making it a renewable resource. We can therefore grow and harvest a sustainable material as we do with our food, while it may be on a longer time scale. Stronger regulations are required in order to lower CO₂ emissions (Lowe, 2001).</p>
Canada	Ontario Province	2012 Wood First Act	Canada legislated through Ontario's Wood First Act (Bill 61), 2012. The purpose of this act is to facilitate a culture of timber use, where provincially funded buildings utilise timber as their primary building material.
UK (2012)	Hackney, London	2012 "Wood First" Policy	Public Consultation – first local authority in England to promote timber construction in its planning policy.
Holland	National	2014 EPDs	<p>The Dutch system for determining the environmental performance of buildings and construction works consists of one environmental calculation method and one LCA/EPD database.</p> <p>Holland is leading the way here by implementing an LCA system which requires EPDs on materials that feed into their assessment tools, thus giving the building an environmental rating, like a BER (Building Energy Rating).</p>
Australia	Wattle Range Council	2015 Wood Encouragement Policy	Wattle Range Council has a policy with four objectives that focus on local employment retention in its local industry, promoting further jobs and investment. The policy also advocates timber use in public works, support of the industry, its produce and encouragement of sustainable plantation resources.
New Zealand	Rotorua Lakes Council	2015 "Wood First" Policy	Rotorua Lakes Council adopted a "Wood First" policy and action plan. Farming wood was first entertained

			and developed in Rotorua, and now is an international practice. The Council’s “Wood First” policy facilitates timber – promoting its sustainable properties in the district, specifically requiring council projects to be constructed in timber, and advocating same for all construction works.
EU	All EU States	2017 EU action plan for sustainability	EU action plan for sustainability. This plan does not mention construction, which is difficult to understand, considering how unsustainable construction procurement is.

3.4.4 Summary

This section investigated construction policy both national and international between the time periods of the case study buildings. The CLT timber house in Tara is not a development of the Killykeen project in the context of design and construction methodology. However, the State was influential with MacBride’s afforestation policy producing Killykeen, which in turn inspired COFORD’s *Woodspec* publication (O’Connor, 2001) and Dr Harte’s CLT research assisting the Tara house project.

Some conflicts are evident in policy, with delays and omissions (highlighted at the end of Tables 2 and 3). These anomalies indicate that the progression of sustainable materials is being resisted, which therefore restricts timbers advancement in the Irish construction industry. This issue may also be related to the size of our institutions and the capacity to share the knowledge constantly being generated. This is evident in the 2003 timber frame housing report for Ireland, which proscribes education. However, this report, like others, has not been acted on, leaving its data in the knowledge vacuum, or more likely on a shelf.

3.5 Academy

3.5.1 Introduction

The last section of the chapter investigates timber's role in the Irish construction industry from a research and educational perspective, framed by the case study buildings. The case study prototype projects, by their nature, deliver research and educational outcomes. This section also outlines the philosophical context of man's relationship with the natural environment.

Table 4 Development of Research and Educational Programmes Directed towards Forestry Prior to the Construction of the Killykeen Holiday Homes

(Table compiled for this research by F. N. Duffy)

INSTITUTION	DATE/TOPIC	DESCRIPTION
Samuel Hayes	1794 Book	<i>A Practical Treatise on Planting, and the Management of Woods and Coppices</i> . Hayes, a member of the Irish House of Commons, was also a founder of the National Botanic Gardens in Dublin, and owner of the well-wooded estate at Avondale, in Co. Wicklow.
Department of Agriculture (DATI)	1899 Forestry	The Department of Agriculture and Technical Instruction (DATI) was formed with responsibility for forestry (O'Carroll, 2004).
DATI	1904 School	Purchase of Hayes and Parnell's old home at Avondale and establishment of a forestry school there, opening in 1906 with A.C. Forbes as its head (O'Carroll, 2004).
UCD	1912 Forestry Training	University training in forestry began in 1912, when Augustine Henry was appointed Professor of Forestry in the Royal College of Science for Ireland, an institution subsequently incorporated into University College, Dublin (O'Carroll, 2004).
DATI	1914 Species sampling	State interest in forestry in Ireland as a vital national resource continues. Several foreign species of conifers, such as Sitka spruce and Douglas fir, planted in earlier years, reach a size and age which demonstrate their value as timber trees and their ability to grow on poorer sites (O'Carroll, 2004).
Society of Irish Foresters	1943 Academic and technical publication on forestry	<i>Irish Forestry</i> is an internationally peer-reviewed journal publishing forestry research articles. It also covers all aspects of practice, technical innovation, history, policy, culture and related areas of forestry

		interest, primarily in Ireland (journalsocietyofirishforesters.ie).
Department of Agriculture	1957 Research Section	Through the 1946 Forestry Act, a research section was established within the Forest Service. The section initially concentrated on silviculture experiments and the initiation of state forests. The section was eventually transferred to Coillte in 1989 (O’Carroll, 2004).
NB – Further bodies established during the case study timeline	Teagasc, COFORD, Wood Technology Ireland, etc.	See Table 2.

3.5.2 Philosophical Perspective

The time between the Killykeen timber frame and Tara CLT projects captures a philosophical shift in the rationale for constructing with timber across the planet. We have recently seen the rapid development of research into man’s place in the environment, illustrating society’s irresponsible actions that are harming the natural world. Killykeen may appear to be at the forefront of this research, but in fact the research here was testing the viability of Ireland’s initial roundwood harvests. The CLT house in Tara, on the other hand, could be a product of Carson’s aim to alter our way of living on the planet (see *Silent Spring*, 1962).

To understand the philosophical view of the environmental in western society, we need to reach further back to Greek philosophy and Plato’s *Timaeus* to identify man’s view of the planet and the cultural legacy its created. According to Hagan (2001, p. 19), “nature, in the West, has been seen as female and inferior, and culture has been seen as male and superior”. Likewise, Le Corbusier (1929, p. 24), claims: “Man undermines and hacks at Nature. He opposes himself to her”. The over-mechanised technological societies of the mid-20th century were behaving in a negligent manner towards the natural world, and this had a reaction calling for protection of the environment against man’s degrading actions.

Man's view of the world as a resource to be exploited brought Hagan to also investigate the technology legacy and the materials we source and manufacture. Banham and Carson, in the 1960s, and Farmer in the 1990s, have asked us to think about our position in a world ecosystem; and modern codes have emerged, obliging man to see nature differently, which is a monumental change from Plato's position.

Today, there is a philosophical shift where society is beginning to understand that we are part of the natural environment. Man's actions are bearing detrimental effects on the environment we inhabit. Therefore, society must consider how to protect the natural system in which it lives.

3.5.3 Research

3.4.3.1 International

Materials have been defining architecture for centuries, from Wren's stone architecture to Georgian brick cities and Victorian industrial steel to Corbusier's concrete form. Today, the world's oldest construction material and plausibly the most sustainable timber is undergoing a revival (de Rijke, 2009).

Science-based environmental literature published internationally on materials has undertaken to identify the place of timber in the material market and the properties that make it a sustainable construction material. This literature is reflected in the case study buildings of Killykeen and Tara, as their designers have used international technology and standards to procure the works.

There are advantages and disadvantages when working with timber, and those that are found to have properties which protect the environment are shown in Table 4. LCA, carbon sequestration, etc., illustrate the unique properties of timber over its counterpart materials.

Table 5 Science based literature illustrating the environmental properties of timber
(Table compiled for this research by F. N. Duffy)

DESCRIPTION	DATE	AUTHOR/S	TITLE
LCA	2008	Kellenberger and Althaus	Relevance of simplifications in LCA of building components
	2009	Abeyesundara, Babel and Gheewala	A matrix in life cycle perspective for selecting sustainable materials for buildings in Sri Lanka
	2009	Monahan and Powell	An embodied carbon and energy analysis of modern methods of construction in housing
	2011	Bribián, Capilla and Usón	LCA of building materials
	2013	Fouquet et al.	Methodological challenges and developments in LCA of low energy buildings
	2015	Higham, Fortune and James	Life cycle costing: evaluating its use in UK practice
Carbon Sequestration	2013	Sadler and Robson	<i>Carbon Sequestration by Buildings</i>
	2014	Make it Wood	Melbourne City Council's 'Library at the Dock' stores 250 tonnes of carbon helping to tackle climate change.
Longevity	1983	Chappell	<i>A Timber Framer's Workshop: Joinery, Design & Construction of Traditional Timber Frames</i>
	2009	de Rijke	<i>Engineered Timber: A Manifesto</i>
Local materials selection	2001	Morel et al.	Building houses with local materials
	2008	Hammond and Jones	Embodied energy and carbon in construction materials
	2009	Castro-Lacouture, Sefair, Florez and Medaglia	Optimization model for the selection of materials using a LEED-based green building rating system in Colombia
	2011	Oikonomou and Bougiatioti	Architectural structure and environmental performance of the traditional buildings in Florina
	2014	Takano, et al.	A multidisciplinary approach to sustainable building material selection
Comparative materials	2006	Gustavsson and Sathre	Variability in energy and carbon dioxide balances of wood and concrete building materials
	2012	Nassén, Hedenus, Karlsson and Holmberg	Concrete vs. wood in buildings – An energy system approach
	2012	Kaufmann and Strauch	A resource-efficient synergy: hybrid timber constructions in buildings
Structural compatibility		www.structuraltimber.co.uk	
	2013	Pei, S., van de Lindt, J. W. & Popovski, M.	Approximate R-Factor for cross-laminated timber walls in multistory buildings
	2013	Raferty and Harte	Material characterisation of fast-grown plantation spruce
	2014	Harte, A., McPolin, D., Sikora, K., O'Neill, C., and O'Ceallaigh,	Irish Timber – Characterisation, Potential and Innovation

Timber has disadvantages, manifested through fire, moisture and comparable materials competing for market share. Timber's legacy with fire, is found in strict regulations against using timber over a certain number of floors. Attempts are now being made to reverse this legacy with prototype building, "Life Cycle Tower" and research illustrating methods that mitigate fire (Kaufmann, & Strauch, 2012), (Yang, T., Wang, S., Tsai, M., & Lin, C., 2009). COFORD and NUIG are in the process of developing national discussion papers on high-rise timber buildings (Harte, & Hendrick, 2017). Equally, the fibrous

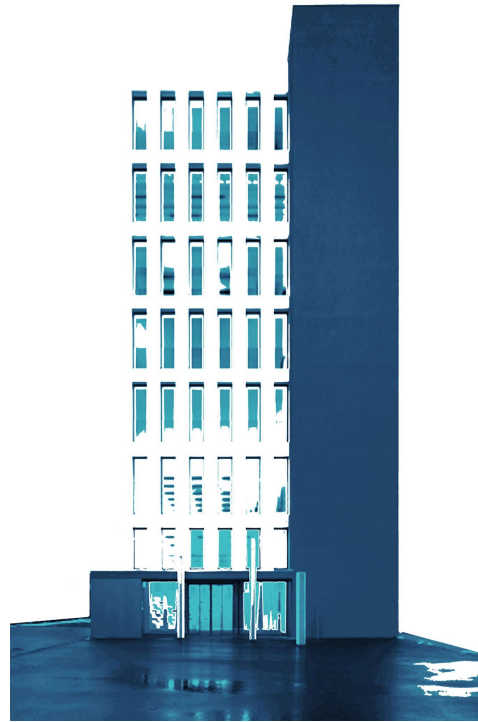


Figure 22: Life Cycle Tower, Austria, 2012
(Source: Image from <http://www.energy-innovation-austria.at/article/lifecycle-tower-lct-one/?lang=en>)

nature of timber makes it susceptible to moisture and precautions are required through specific detailing relative to the climatic conditions (Hameury, 2004). As with most competitive markets, the construction industry has a materials propaganda war waging for market share, each side funding research to herald its product, as referenced. It was reported that cement carbonisation offsets 43% of the CO₂ emissions from production of cement, excluding emissions associated with fossil use during cement production (Xi et al., 2016). Studies have also been carried out to compare concrete and timber (Gustavsson, & Sathre, 2005; Nassén et al., 2011).

Pressing environmental considerations have led to international research into sustainable materials, which is showcasing the advantages of timber over its counterpart materials.

However, market forces, policy direction and a lack of practice knowledge are impeding its progress.

3.5.3.2 National Research

Timber has many properties and with modern science we are now able to classify the material against its comparators. Two of the most important factors are structural strength and energy input. Modern timber technology has evolved, in a short period of time, from a hands-on craft material (Killykeen Holiday Homes) to one which is manufactured (Tara House.), allowing standardisation of products parallel to concrete and steel (Structural Timber Association, 2014).

State research into timber in Ireland began in 1957, when a research section was established within the Forest Service under the 1946 Forestry Act. In 1993, COFORD was established as a stand-alone government body responsible, under the DAFM, for R&D (Table 2). The body has a remit to provide research programmes, publications and events with the intention to forge and nourish industry and research relationships. For example, *Woodspec* (O'Connor, 2001) (see Table 2) is a guide to designing, detailing and specifying timber in Ireland. The book was developed by the OPW architect Ciaran O'Connor, who designed Killykeen and funded by COFORD. Today's timber fabrication systems have developed beyond the hands-on craft technology of the 1980s, and COFORD has supported Wood Technology Ireland (WTI), a national information service for the timber sector.

The COFORD's all Ireland roundwood production forecast 2016-2035 predicts a 100% increase in roundwood production, placing the sector in an advantageous position. With the



Figure 23: COFORD BIOECONOMY Report Branding Image, 2017
(Source image from <http://www.coford.ie/media/coford/content/publications/cofordarticles/COFORDBioeconomyReport290917.pdf>)

carbon emission obligations, COFORD sees the opportunity of developing a strong bioeconomy. This sustainable economic model is one which offers holistic sustainability, where policy not only delivers for the economy, but also covers environmental and social sustainability. This forestry bioeconomy is in its infancy, but has a thriving export business, creating sustainable rural jobs, while mitigating carbon emissions (COFORD, 2017).

COFORD has links with NUIG, where funding has been awarded to the engineering department. Dr Harte is conducting studies on the potential of CLT with Irish grown Sitka Spruce. Harte's research has led to academic articles and conferences (Harte, 2014; 2016). She has also collaborated with Eugene Hendrick (COFORD Director) developing a national discussion paper on high-rise timber buildings in Ireland.

Further state funding mechanisms are investigating the potential of timber for the Irish construction industry. Examples include DAFM research under CasWood funding, to harmonise existing data sets on emissions, carbon storage, and fiscal measures conducted by UCL and UCD under Dr Ken Byrne and Dr Elizabeth Shotton respectively. The aim is to create a management system to reduce waste in the forest products resource chain.

Another example includes the experimental study of timber-to-timber composite beams using welded-through wood dowels. It is recognised in this study that timber is more environmentally friendly than steel or concrete. Glulam technology is flexible and offers varied systems of assemblage, but its manufacture is energy intense, and fire is an issue with regard to steel fixings. Therefore, the study proposes the use of welded wood dowels as connectors over traditional metal (O’Loinsigh et al., 2012).

Independent research dissertations have also investigated the potential of native Irish timber, indicating that current methods of construction are not environmentally sustainable without causing detrimental harm to the planet. Concrete and steel require displacement, providing environmental sustainable solutions. Farming diversification delivers this through state funding, where forestry, due to its ecological attributes, is carbon negative, compared to open-pasture beef and dairy (Gouth, 2015). While research has been undertaken to identify potential productivity of Sitka spruce through national modelling and mapping, the Food Harvest 2020 policy aims to achieve a 50% increase in milk output, which will impact on land availability for forestry (Farrelly, Ní Dhubháin and Nieuwenhuis, 2011).

Science-based research into the potential of Irish timber is being conducted on many levels, including structural suitability, its positive environmental properties over its counterpart materials, stock management, and the development of a bioeconomy. Where this research is folded into practice within the sector, a self-sufficient industry is possible, which will be of great benefit to Irish people’s wellbeing.

3.5.4 Education

Killykeen could be seen as an educational exercise, conducted by the OPW architects and the Forestry & Wildlife Service in apprehension of Ireland’s initial roundwood harvest, and seeking the viability of Irish native species as a material in the building sector. The project

initiated *Woodspec* (O'Connor, 2001), published by COFORD, which assisted with the procurement of the CLT house in Tara. A new edition of *Woodspec* is being considered, which will be designed as a more user-friendly version for site works and quick reference.

Post Killykeen, DAFM established a number of state bodies in response to the increased harvesting of roundwood crop. In 1988, the Forestry Act established Coillte with the remit to manage Ireland's state forestry in an innovative and sustainable manner. Teagasc was established, with responsibility for the provision of research, training and advisory services. COFORD was established, in 1993, under the National Development Plan, with an R&D remit in the Forestry sector. *Woodspec* (O'Connor, 2001) is one of several publications produced by COFORD, which also funds research and maintains collaborative relationships with the national universities, not least NUIG, with Dr Harte, who is involved in numerous research projects on Irish timber and its structural potential. The year 2016 also saw the establishment of Wood Technology Ireland, supported by COFORD, with DAFM funding. WTI provides technical advice and information to construction professionals on regulation compliance.



Figure 24: State Bodies & Collaborators whose Research is not being Disseminated to Undergraduate Students (Source: Images from institution/company webpage)

The state bodies and associated postgraduate research collaborators are powerful advocates of timber in the Irish construction industry, but it is apparent that the undergraduate cohort is missing this knowledge dissemination. This part of the education system is falling short in the delivery of sustainable education (McManus, 2016). Experts in the field who took part in the interviews process of this study concur, expressing concern over how a major material is not being covered in structural engineering programmes, nationally. This vacuum is also a feature in the apprenticeship programme, where the pre-Celtic Tiger delivery model has remained the same, failing to upskill educators in contemporary building construction methodologies, coupled with wood-cutting machinery not being fit for purpose.

Evidence illustrates that the current third-level education model is not equipping future construction professionals with the technical skills and understanding that will allow them to evaluate economic, social and environmental sustainability (McManus, 2016).

3.5.5 Section Summary

This section of the chapter investigated the discourse around the role of timber in the Irish construction industry from a research and educational perspective, using two case study buildings constructed in timber to frame the work. To further understand the context, philosophical positions were also considered, since the way in which we provide materials for the built environment is now an international concern and is affecting material procurement. The evidence shows there is substantial research being carried out both internationally and here in Ireland, investigating and testing the viability of timber as construction material. This includes the Killykeen and Tara case study projects. However, the research is being disseminated to the forestry sector, largely through Teagasc and COFORD, and technical information is available to practicing professionals, but is limited. Third-level dissemination is also limited, whereby timber as a material is not presented as having parity with steel and concrete counterparts.

3.6 Chapter Summary

This chapter investigated the literature discourse of the underutilisation of timber in the Irish construction industry. The discussion first considered the historical legacy of Irish timber.

This information provided a context for the research, and highlighted the fact that deforestation resulted in the full depletion of timber as a construction material, hence creating a masonry construction culture. Philosophical perspectives were also considered, looking at how historically, western culture related to the planet's environment. This presented itself as an evolving mind-set from exploitation to protection, which has an international movement spearheading environmental legislation.

The main body of the literature discourse was divided into procurement, policy and academy sections and framed between two case study exemplar timber buildings: Killykeen Holiday Homes in Co. Cavan, designed by the OPW in 1984, and a private CLT house in Tara, Co. Meath by Jackson + Groarke, 2017. The narrow focus allowed an in-depth study, taking two buildings procured 33 years apart. This approach to the research sought to identify weak and positive factors that affect the development of timber in the Irish construction industry.

The literature has a mixed and sometimes conflicting reading, as the procurement, policy and academy sections all have positive and negative elements affecting the progression of timber today.

Internationally, timber construction technology is being revolutionised and many nations are buying into the material, mainly due to its environmental properties and their existing timber culture. Ireland can be considered a progressive nation, but does not appear to be embracing timber construction technology. Or, is it? There is a firm underlying foundation moving forward in all three of the research themes, including state policy, R&D funding, and timber buildings being constructed. However, a number of factors, including knowledge vacuums

across the sector, and industry lobbyists, protecting their market share, resisting policy implementation – which leaves the construction industry in a stasis.

This literature discourse has illuminated various areas of the Irish construction industry that suggest why timber is being underutilised. The next chapter of the research uses these issues to further investigate these areas, in the form of a parliamentary question, a local authority council policy motion, and a series of interviews to national experts and stakeholders.



*Figure 25: Interview Participant Expert and Industry Stakeholder Organisation Logos
Source: Images from institution/company webpage)*

CHAPTER 4

Research

4.1 Introduction

Chapter 4 sets out the research methods used to further the base information gathered in the literature review. Three methods were used to gain a deeper understanding of why timber is underutilised in the Irish construction industry. The first two engaged directly with the Irish political system, initially through a county council motion testing the research against the State's position on timber and public representatives. The second engagement was via a parliamentary question, seeking information on state afforestation. The third method used fourth-generation evaluation in a two-stage interview process analysing the participants' discourse. These methods produced findings that illustrate why timber occupies its current position in the Irish construction industry.

4.2 Wood First Policy

As part of my intentions to implement the findings of the research for this degree in the real world of policy-making, I proposed a "Wood First" policy in SDCC, following international policy positions. On 10 July 2017, SDDCC Motion No. 09 was debated by the councillors and council officials as follows:

Table 6 South Dublin County Council Motion 09
(Table compiled for this research by F. N. Duffy)

Motion 09 Proposed by Cllr. Francis Noel Duffy	"That this Council adopts a 'Wood First Policy' to facilitate a culture of wood, by requiring the use of wood as the primary building material where practical in all new and modified South Dublin County Council funded buildings. In a manner consistent with the Irish Building Regulations and National/EU sustainability policy objectives that substantially reduce embodied energy and CO ₂ emissions, which in turn protect our environment. Similar policies exist across the globe, some include the Wood First Act in British Columbia, Japan's Law No. 36 of 2010 promoting the use of Wood materials for Public Buildings, and closer to home in 2012 Hackney in
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	London became the first Local Authority to promote timber construction in its planning policy”.
SDCC Official Response to the Motion	“Like all building materials, however, wood has limitations as well as advantages. Provenance of hardwoods, distances travelled, structural and load-bearing restrictions and problems of ongoing maintenance in a wet, humid climate like Ireland’s can create concerns about the universal use of wood construction. Fire safety concerns render wood unsuitable for certain types of structures – Tallaght Stadium and the park pavilions are not appropriate projects for wood as a first choice. The Council will seek to use wood wherever possible practical and a suitable choice following design analysis but advises against legislating for wood as a ‘first choice’ in all projects’.

The motion was tabled not only to promote the use of a sustainable construction material, but to test the State’s position in a public forum. SDCC cited concerns over structure, availability, fire and climatic limitations, advising the councillors not to pass the motion. One purpose of the present research was to prove that these concerns were unfounded, as technology, along with appropriate design, has overcome these issues. Making this argument in the council chamber, following the official rebuttal from SDCC, the councillors voted unanimously to pass the motion, making SDCC the first council in Ireland to have a policy promoting the use of timber.

Further to a press release on the motion, thejournal.ie (2017) published the story with the headline “South Dublin has committed to building more buildings out of wood”. The article created an interesting online debate on the issue. Comments at either end of the debate included “When all the buildings go up in flames. Then people will see the problems” to “ignorance is bliss they say but it’s also, unlike a well designed and constructed timber building, very dangerous. Check your facts on timber before spouting rubbish about fire. It has a predictable charring rate which means it is self-extinguishing. Large timber beams will maintain their structural integrity when steel beams may warp, bend or twist and concrete can crack. I can

send you loads of info if you want. The best, safest, thermally efficient and most ecologically sound buildings going up in Ireland today are using factory manufactured timber frames, fact!.”

The article received 57 for and against comments, which highlighted a knowledge gap and negative perception regarding timber.

Shortly after the article, an SDCC communications official asked me to remove the article, citing that the information was misleading. However, the press release only included the motion facts as recorded in the council meetings minutes. This reaction highlighted that the council was not comfortable with the policy, which is notable, considering that Irish local authorities have a remit to promote sustainable procurement under the EU GPP (*Public Procurement for a Better Environment*, 2008).

4.3 Parliamentary Question

The expert interview process revealed an anomaly with respect to why the State halted national afforestation. A number of the stakeholders had different opinions on the timing of when the State ceased afforestation, and why the process had stopped at all. In order to find an official answer to this question, I used the parliamentary question process.

As Coillte is a semi-state body and is co-owned by the Minister for Finance and the Minister for Agriculture, Food and the Marine. It is subject to Irish parliamentarians asking question of the appropriate ministers on the workings of the State. I approached my spouse (Catherine Martin TD) to submit a question to the minister, as set out in Table 7. The response clarified the question.

Table 7 Parliamentary Question

(Table compiled for this research by F. N. Duffy)

DÁIL QUESTION	
NO: 245	“Addressed to the Minister for Agriculture, Food and the Marine (Deputy Michael Creed)”
By	Deputy Catherine Martin for WRITTEN ANSWER on 18/05/2017
To ask the Minister for Agriculture, Food and the Marine	the reason Coillte has stopped afforesting; and if he will make a statement on the matter.
REPLY	<p>Coillte CGA was established as a private commercial company under the Forestry Act, 1988 and day-to-day operational matters, such as the management of their forest estate, are the responsibility of the company.</p> <p>The matter was, however, raised with Coillte who advise that the company does not qualify for the afforestation grants and premium payments that are available to the private forest sector under the Forestry Programme, which are an incentive for other landowners to afforest their land. Coillte added that, notwithstanding this ineligibility, the company continues to look for options to establish new forests where it makes commercial sense to do so and is actively considering the role it can play in facilitating the overall growth of the national forest estate. The company further advise that it has recently taken steps to play a role in the private forestry sector through the launch of its Coillte Premium Partners initiative, which is aimed at strengthening the broader industry and on increasing the mobilisation of the private timber resource.</p>

4.4 Interviews

4.4.1 Introduction

As outlined in Chapter Two, a two-stage interview process was designed with fourth-generation evaluation (Guba, & Lincoln, 1989), allowing for deeper discourse analysis of the research (Markus, & Cameron, 2002).

4.4.2 Stage One Interview Design

The first interviews required national experts (Table 8), one selected for each of the literature themes (policy/academy/procurement). The interviewees were asked a series of broad questions identified in the literature (Table 9), in order to elicit responses relative to their professional experience with timber in the Irish construction industry.

Table 8 National Expert Interview Panel
(Table compiled for this research by F. N. Duffy)

Field	Expert
PROCUREMENT	Architect (Procuring timber buildings)
POLICY	Public Official (OPW, State Architect)
ACADEMY	Academic (Researching State funded Irish Structural timber)

Table 9 Stage One Sample Interview Questions
(Table compiled for this research by F. N. Duffy)

No.	Sample Questions Include:
01	Is the state policy facilitating timber technology?
02	Is the state research facilitating timber technology?
03	Does timber technology have momentum in the Irish construction industry?
04	Who are the players effecting the timber progression?

4.4.3 Stage Two Interview Design

The second cohort of interviewees comprised industry stakeholders, selected to represent the spectrum within each theme of the literature (Table 10). The data gathered from the first stage of interviews was analysed and refined into five questions (Table 10). The opening questions were broad and the last three were specific to particular areas of the literature themes that appeared to be suppressing the potential of timber in the Irish construction industry.

Table 10 National Stakeholder Interview Panel
(Table compiled for this research by F. N. Duffy)

Field	Stakeholder
PROCUREMENT	Representative from the cement industry
	Contractor/developer of timber housing
	Coillte (did not respond)

POLICY	Teachta Dála (member of the Irish parliament)
	Regional Assembly Director (regional public official)
	Planning Director (local authority public official)
ACADEMY	COFORD Director (Forestry R&D public official)
	School of Trades, DIT (former acting head)
	Undergraduate lecturer of Architecture, DIT
	Academic Advisor and Partnership Coordinator, DIT

Table 11 Stage Two Interview Questions
(Table compiled for this research by F. N. Duffy)

No.	Question
01	Do the Irish people have an appetite to embrace environmental sustainability?
02	Should the State locally and nationally be funding timber buildings – setting an example for the private sector to follow?
03	Can public policy assist the progression of timber as a material in the construction sector? If it can, how? And, what mechanisms could be put in place?
04	Fire and moisture in timber construction detailing appear to be holding back the material. Can regulation in the form of standard details and certification resolve this inertia?
05	Should the State endorse and finance CPD (continuing professional development) for professionals, educators and apprentices to give these players the construction knowledge required?

4.4.4 Section Summary

Interviews with experts and stakeholders in the Irish construction industry on the research question were the main research method used to gain the most relevant data to analyse the discourse. Two sets of interview questions were designed, based on the research question and themed relative to procurement, policy and academy. The first set was used to explore the literature discourse to identify and hone in on factors which are impeding the progression of timber. The second set of interviews took the identified issues from the expert interviews,

refining the data into five specific questions. The interview discourse is analysed in Chapter Five to find patterns, metaphors, and conducive and reformulating language, to identify why timber is underutilised (Markus, & Cameron, 2002).

4.5 Chapter Summary

The research methods were used to isolate factors that identified conditions which cause the underutilisation of timber in the Irish construction industry. A narrow-themed literature review provided base data for field work in the form of a local authority “Wood First” policy motion and parliamentary question, both providing official state positions. Sample interviews of experts were designed to identify the main factors causing the underutilisation of timber in the Irish construction industry. These factors were developed into five industry/stakeholder interview questions, which identified conditions that limit the progression of timber in the Irish construction industry. The collective findings are analysed in Chapter Five.

CHAPTER 5

Findings Matrix

5.1 Introduction

This chapter concentrates on the analysis of the discourse recorded through the two-stage interview process. The objective of the interview process was to investigate the underutilisation of timber in the Irish construction industry, given its environmental properties. The analysis concentrates on the discourse generated from the five questions set for the industry stakeholders. The expert interview discourse is included where appropriate to the question.

Due to the complex nature of the place of timber in the Irish construction industry, a visual matrix (Fig 26) of the combined research discourse has been constructed to illustrate the relationships and gaps within the sector.

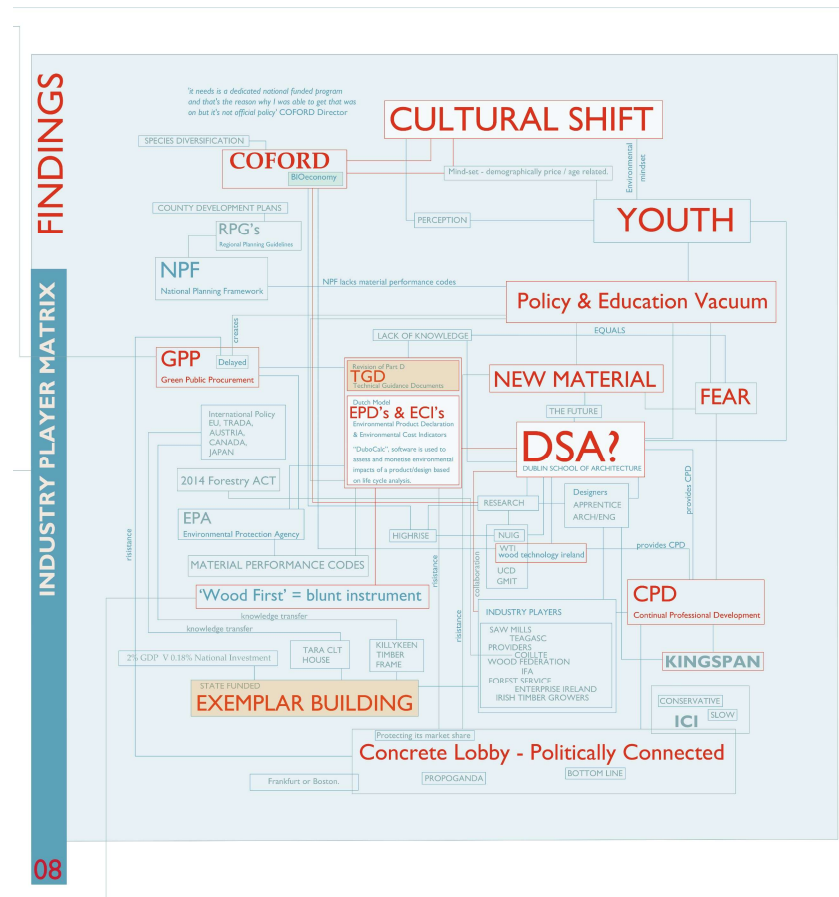


Figure 26: Research Findings Matrix. (Source: Image by F. N. Duffy)

5.2 Analysis of expert and industry stakeholder interview discourse

A combined total of 12 expert/industry stakeholders participated in the research interviews (three national experts and nine industry stakeholders). Five areas covering the research question formed five questions, which were put to each of the interviewees. Questions and stakeholders are listed in Tables 8-10.



Figure 27: Samuel Beckett Civic Campus, Ballyogan, Dublin (Timber-framed Structure)

(Source: Image from <https://www.bmcea.com/>)

Question 01
Does the Irish Public have an appetite to embrace environmental sustainability?

The perception of stakeholders towards protecting the natural environment varied. A total of 50% felt that primary and secondary education, alongside modern communication technology, was making the younger generation believe that protecting the environment was important. This view was absent from the generation of the interviewees (45-60 age group). Current school education programmes were the factor highlighting the importance of protecting the environment. The price attached to environmental protection was seen to prohibit its support, along with demographics, where the working class required upskilling in the operation of sustainable dwellings. One firm position demonstrated that the appetite for environmental sustainability did not exist, and when pushed on the youth aspect, provided evidence to illustrate how the younger generation were not prepared to lower their standard of living to

protect the environment. Two examples were provided: (1) DCU students are not willing to do without' hot water in wash-hand basins, even though hot water is not more hygienic; and (2) young people are not willing to holiday locally to reduce their carbon footprint. It would appear that a cultural shift is taking place; that Irish society is seeing the importance of protecting the environment; and that school education and the global village are informing younger people of the fragility of the environment.



Figure 28: Cross Laminated Timber McEwen School of Architecture, Ontario, Canada
(Source: Image from <http://entertainmentsudbury.com/events/mcewen-school-architecture-official-grand-opening/>)

Question 02

The EU's Green Public Procurement (GPP for a better Environment) obliges EU public authorities to lead the way through their own sustainable procurement practices, with a view to shaping public perception.

Should the State locally or nationally fund timber buildings – setting an example for the private sector to follow?

Seven of the 12 stakeholders strongly advocated that the State should invest in exemplar projects that serve as knowledge-building programmes for the wider public and the Irish construction industry players. The public officials (stakeholders) conflicted on state investment, and one felt it should be left to the market, as it is not a risk the State should bring upon itself. Another believed that the State can step in when a cultural shift is required,

referencing the Dublin Docklands, and the third official felt that, without a doubt, the State has to invest on so many levels (socially, environmentally and for educational purposes). There is a wide range of beliefs across the spectrum of the public service, which provides opportunity for timber, if handled correctly.

The contractor and political stakeholders noted that bottom-line policy mechanisms (lowest price) on state tendering do not favour sustainable development. This local authority's tendering policy contradicts the 2008 EU GPP, where all local authorities are obliged to procure in a sustainable fashion, in order to shape the public's perception of sustainable values, encouraging private practice to follow suit. Ireland has continuously delayed publishing its national GPP, with stakeholders citing construction industry lobbyist resistance. It would appear that the State is open to sustainable policy (Table 2), but resistant to carry out sustainable procurement is evident, and this may be due to external dictation.

A further outcome of this stakeholder question saw a public official and cement industry stakeholder concurring with the strong opinion that clever policy should incentivise timber through material performance criteria, and allow the market to adjust. A model recently established by the Dutch was cited (Table 3), which monetises the environmental performance of construction materials at tender stage, mitigating environmental damage. It is apparent that our own building regulation Part D Materials and Workmanship is lacking, with only two pages covering materials.

Question 03
Can public policy at any level assist the progression of timber as a material in the construction sector, if it can HOW and what mechanisms could be put in place?

The response to this question is quite damning of the public service, where delays, inaction and manipulation are directing policy.

The cement industry stakeholder highlighted that until the national GGP is published, the construction industry is in a vacuum regarding environmental material performance, kept on permanent hold by industry lobbyists. He continued, noting that when the policy is published it will not be non-obligatory. The undergraduate lecturer stakeholder commented on how research can be used to manipulate legislation, citing that “whoever pays the piper calls the tune”. The public representative stakeholder who sits on the Dáil housing committee noted that environmental considerations are not on their agenda with respect to the national housing crisis.

The local authority stakeholder claims that the State is the environmental custodian and that sustainability will drive policy and the building regulations will set the standard for the construction industry. The expert policy stakeholder noted that the *Woodspec* state publication (O’Connor, 2001) was delivered for professional consumption. However, the architect stakeholder found *Woodspec* limited with respect to the design and construction of a CLT building, and had to go outside the State for technical information. It should be noted that the expert policy stakeholder who authored *Woodspec* commented that architects do not read. Both the policy expert stakeholder and the school of trades stakeholder commented on the lack of state policy promoting the modernisation of our apprentice programmes, considering how technology has advanced over the past two decades, but the knowledge delivered is the same.

While the question produced evidence of resistance towards environmental policy, the Killykeen project is tangible proof of the State assisting the progression of timber. The year 2017 can also be assured of the promotion of timber, with the collaboration between the COFORD stakeholder and the expert academic stakeholder producing a discussion paper on high-rise timber building standards to be presented to local authorities and the Department of the Environment, Community and Local Government.

There appears to be a battle within public policy, whereby resistance is coming from some public officials and a promotion of timber from others. There is growing momentum from the public to protect the environment, as illustrated from the unanimous passing of the “Wood First” motion in SDCC.



Figure 29: Poustinia Retreat Centre, Co. Tipperary, 2005 (External Timber Cladding)

(Source: Image from Tom Maher MRIAI)

Question 04

Fire and moisture in timber construction detailing appear to be holding back the material. Can regulation in the form of standard details and certification resolve this inertia?

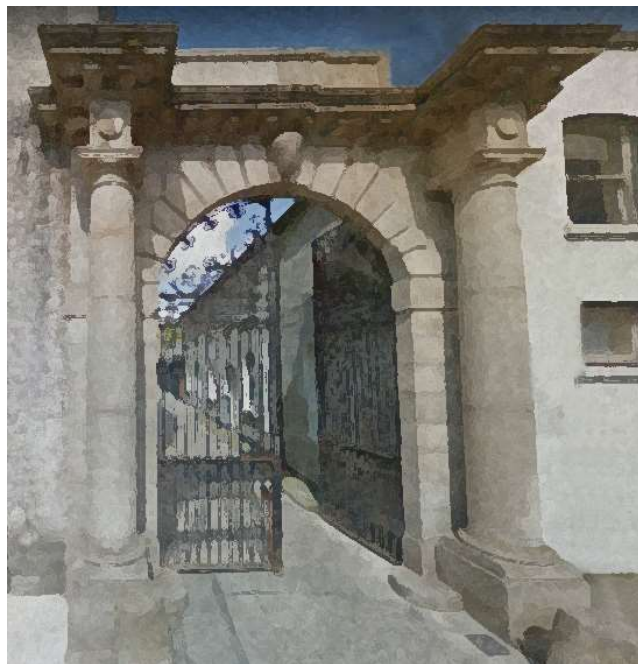
The absence of timber construction knowledge was the main response to this question: “Tradition prevails to educate through steel and concrete” (expert academic stakeholder). The Academic Advisor and Partnership Coordinator stakeholder noted how designers know how to use concrete, and minimal delivery in higher education is producing ignorance. The expert policy stakeholder could not understand why timber is not being taught at third level on an equal footing to steel and concrete.

The school of trades stakeholder felt the apprentice entry level should be raised and that current programmes are not disseminating adequate contemporary knowledge. The public

representative stakeholder concurred with the school of trades stakeholder, explaining that at a Dáil housing committee workshop on apprentices highlighted the non-evolving apprentice system here and in the UK, compared to the Continent, where apprentices are treated professionally in the industry, alongside architects and engineers.

The cement stakeholder expressed the negative perception towards timber: “When you see timber it’s in a fire”. The local authority stakeholder concurred with this sentiment, noting that timber is considered a low-quality material in Ireland, unlike Europe. The undergraduate lecture stakeholder cited fear as an issue, and Reyner Banham (1969) also writes of architects being loth to take a risk, as practice mistakes lead to career endings.

This knowledge vacuum can be attributed to our deforestation legacy and the masonry culture that evolved through the absence of timber. Action has been ongoing since the Killykeen project was initiated, with investment in timber production and how we can utilise the material. However, there is a lack of knowledge in the construction industry of people who can design and build in timber. The Dublin School of Architecture has an opportunity here, as its Timber Product Technology programme is under review. The school could place itself in the national matrix to assist in filling the knowledge gap in timber construction.



*Figure 30: Dublin School of Architecture, 2017
(Source: Image from <https://www.google.ie/maps/@53.3515364,-6.2704241,3a,90y,299.33h,92.06t/data=!3m6!1e1!3m4!1sVokzaAAdhidIA5q4kyq57g!2e0!7i13312!8i6656>)*

Question 05
Should the State endorse and finance CPD for professionals, educators and apprentices to give these players the construction knowledge required?

One of the overriding factors contributing to the underutilisation of timber in the Irish construction industry was a lack of knowledge. The local authority stakeholder believed that the State could be the catalyst to raise awareness, but noted that “*the construction industry is very very powerful, conservative and slow to change, adding that there would be resistance*”. This sentiment was echoed by the academic expert stakeholder, who said that concrete would fight back; and the Academic Advisor and Partnership Coordinator stakeholder suggested that people’s perceptions have been misguided by propaganda, with the push to crush the timber frame industry in the boom: “Better built is crazy stuff”. His research students found construction companies advocating environmental procurement practice in their corporate policies, but not practising their own corporate policies. The contractor stakeholder felt this practice was also evident in local authorities. The architect stakeholder recalled lectures from the concrete industry in which most of the slides showed burning timber buildings. Where discourse is constantly portraying negative messaging, the message eventually becomes the common sense, resulting in timber having a negative connotation.

The expert policy stakeholder stated that no knowledge equals no confidence, and where there is a knowledge deficit, people fall back on the easy default position – concrete. This is a classic scenario, where the tutor asks the student architects what materials they are using for their project, and the students ponder and then say “concrete”. The majority of the stakeholders agreed that the State should sponsor CPD, but it would appear the State has its hands tied. This is evident through its delayed and limited policy on material performance standards and the position taken on the “Wood First” motion.

5.3 Summary

This chapter analysed the discourse recorded through the two-stage interview process. The aim of the analysis was to identify why timber is underutilised in the Irish construction industry. A complex field with multiple relationships, gaps and resistance is revealed, where public officials have varying positions and conflicting policies. There is resistance from a traditional construction industry, coming from different sections, including vested interests protecting their market share and professionals/contractors, who lack technical knowledge, fearing litigation. It is also apparent that CPD is required to upskill the workforce if timber is to become a mainstream construction material in Ireland. Behind all of the resistance, knowledge vacuums and policy delays there is momentum in the timber industry, as parts of this large industry see the potential of timber, and for the time being move it slowly forward.



*Figure 31: Tamedia Office in Zurich, Switzerland, 2014
(Structural Timber Frame – without Steel Fixings)
(Source: Image from http://www.shigerubanarchitects.com/works/2013_tamedia-office-building/index.html)*

CHAPTER 6

Conclusion & Dissemination

6.1 Conclusion

The research was principally concerned with the role of timber in the Irish construction industry, and understanding why the material is underutilised, considering its environmental properties.

The study used a qualitative methodology, utilising defined literature, actioned-based research and interview methods to collect the data. The existing literature in the field was framed by two case study timber buildings, one constructed in 1984 and the other in 2017, and the literature was further defined by procurement, policy and academy themes. This literature was used as a base from which to execute actioned-based research by supporting a local authority “Wood First” motion: a process which, apart from feeding into the interviews, provided an official state response to the research question. The interviews were designed in two stages to allow deeper investigation into the areas that were being identified as restricting the progression of timber in the Irish construction industry.

The discourse collected from the research was analysed, applying fourth-generation evaluation in the interview process. The overall research discourse was illustrated (Fig. 26), providing a findings matrix, which revealed relationships, gaps, resistance and vacuums across the Irish construction industry. The main discourse findings highlighted a number of issues, ranging from a lack of timber construction knowledge, resistance from a conservative construction industry, and public policies that were delayed, conflicted or limited.

6.2 Recommendations

The purpose of the research was to understand why timber is underutilised and, where possible, to use the findings to shape future policy that promotes timber in the Irish construction industry. Two areas the findings point to are material performance policy and education. There is reasonable potential for me to continue working towards material performance standards through my political mandate at local, regional and national levels. I also have an educational remit to Dublin School of Architecture, and the prospect of filling the knowledge gap via through the educational programmes I lecture on, including the Architecture Degree and the Timber Product Technology programmes within the Dublin School of Architecture.

6.3 Dissemination

Research at master's level requires a formal dissemination medium, in order for its reach to be maximised. Initial findings pointed to gaps in construction knowledge across the education system. A target audience, distribution mechanism, medium choice and funding made up the brief for this element.

Consideration was given to various forms, including a travelling exhibition, and an initial design for this was presented, covering the seven architectural schools in Ireland. This approach was abandoned due to its limited audience, and an alternative medium was chosen.

The alternative medium was considered to have a greater reach and a desired educational effect. This medium was a white board animation with a poster, with a target audience narrowed down to Transition Year students. The Irish Architecture Foundation was approached with respect to its Transition Year National Architects in Schools Initiative, and the potential incorporating the animation into this educational programme, which is under review in 2018. COFORD has a funding mechanism which will be applied for with respect to professionally producing the animation, poster and booklet from their existing prototype forms. Where the Irish Architecture

Foundation and COFORD are amenable to this proposition, each party will become an effective client for the dissemination, therefore requiring particular outcomes to meet its needs.

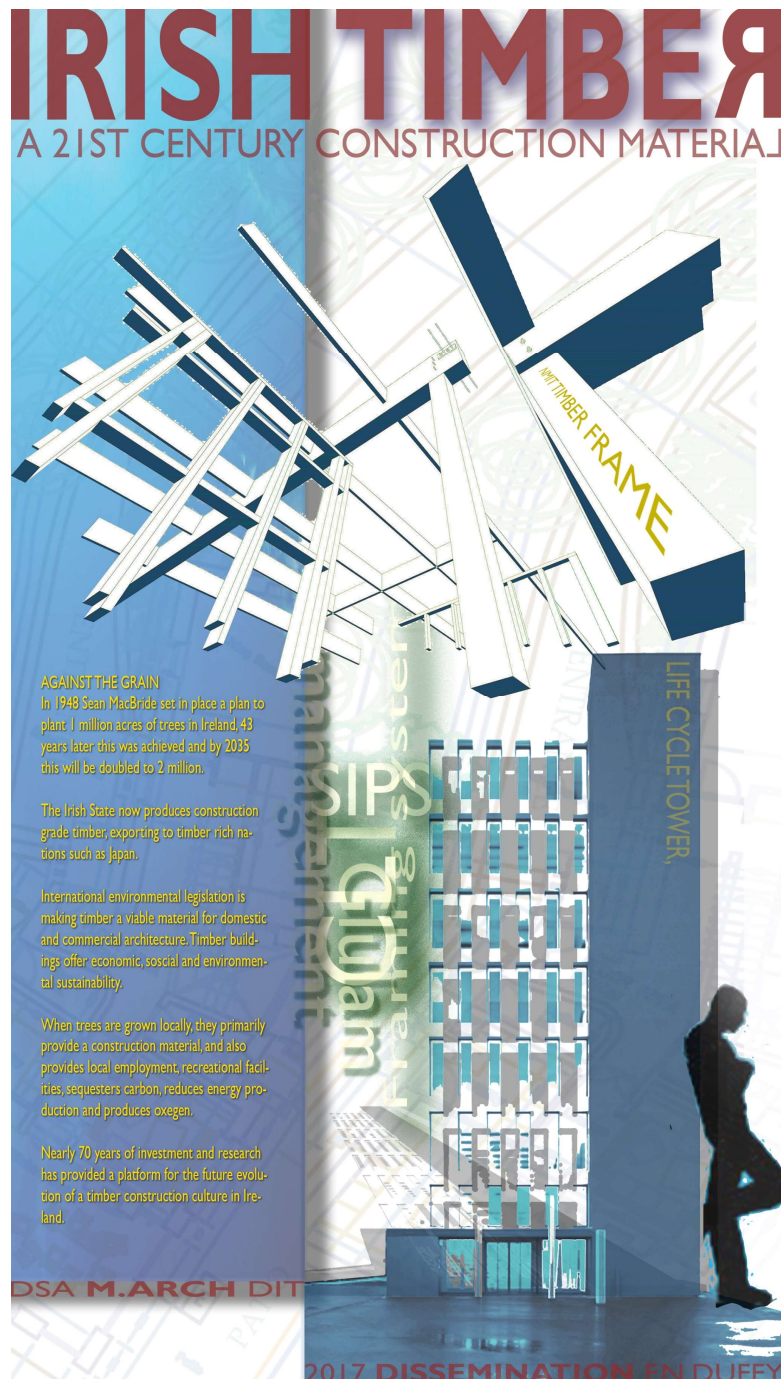


Figure 32: Dissemination Poster
(Source: Image by F. N. Duffy)

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